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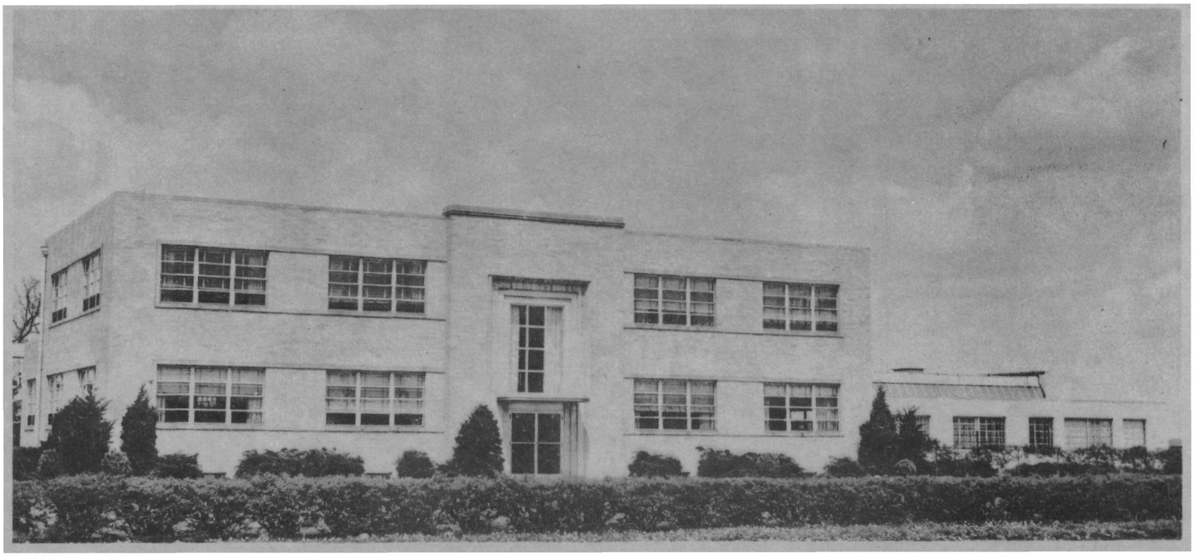


RESEARCH FOUNDATION

USNC-IGY ANTARCTIC GLACIOLOGICAL DATA
FIELD WORK 1958 AND 1959

(South Pole Station)

Report 825-2-Part IV
IGY Project No. 4.10
NSF Grant No. Y/4.10/285

Mario Giovinetto
April 1960

ERRATA SHEET FOR REPORT 825-2-IV

Please make the following corrections in your copy.

(1) On page 11, line 12, Ref. 15 should read Ref. 13.

(2) On page 12, line 2, Ref. 16 should read Ref. 14.

(3) On page 12, line 5, Ref. 17 should read Ref. 15.

Add Ref. 17 as follows:

17. Instructions for Snow Observations, Sipre Instruction Memorandum No. 1, Snow Ice and Permafrost Research Establishment, Corps of Engineers, (1952).

USNC-IGY ANTARCTIC GLACIOLOGICAL DATA

Report Number 2: Field Work 1958

Part IV

SOUTH POLE STATION

The Ohio State University
Research Foundation
Columbus 12, Ohio

Project 825, Report No. 2, Part IV

Submitted to the

U. S. National Committee for the IGY
National Academy of Sciences, in partial fulfillment
of IGY Project Number 4.10 - NSF Grant No. Y/4.10/285

April 1960

ACKNOWLEDGMENTS

The author wishes to thank James B. Burnham, seismologist at Pole Station, for his willing assistance in the field work, and Richard L. Cameron, for editing the manuscript. Mrs. Faye Smith and George Van Niel performed the tedious tasks of typing and drafting, respectively. The interest of Dr. Henri Bader in some aspects of these data is appreciated.

Mario B. Giovinetto

GLACIOLOGY REPORT FOR 1958

SOUTH POLE STATION

by

Mario B. Giovinetto

LIST OF FIGURES

LIST OF TABLES

GLACIOLOGY REPORT FOR 1958

SOUTH POLE STATION

o - o

Mario B. Giovinetto

GLACIOLOGY REPORT

SOUTH POLE STATION, 1958

by

Mario B. Giovinetto

Introduction

The Pole Station (IGY Amundsen-Scott Station) is located within 1 km. of the geographical South Pole, 2800 m. above sea level (1) where the ice is approximately 2400 m. thick (2).

Glaciological observations were made from 5 January to 26 November 1958. The main effort was directed toward obtaining information on the area's present and past snow accumulation, on the physical characteristics of this snow, and on the relationship of the accumulation to meteorological conditions.

This report presents the pit stratigraphy and stake measurement data collected for studies of snow accumulation and observations on firn temperatures.

Later reports will cover observations on solid particle content of the snow, snow mechanics, and fabric of deep core. Firn samples were taken for oxygen-isotope studies and were delivered to the California Institute of Technology. Other observations, such as precipitation crystal replicas, were made by other personnel. Their reports will be available elsewhere.

Preliminary Considerations

Weather

Weather data collected by United States Weather Bureau personnel during 1957 were available in part at the Station. Because certain conditions of weather reflect on the characteristics of the snow cover, a brief summary of 1957 weather observations is given below in approximate figures.

Air temperature, 2.5 m. above the snow surface. The mean annual air temperature is approximately -50°C. From March to October inclusive, the daily mean temperature ranged between -50° and -65°C., with few exceptions. There were two transition periods, when daily mean temperatures decreased (February), and increased (November) between -50° and -30°C. During December and January the daily mean temperatures ranged between -30° and -20°C. A minimum temperature of -75°C. and a maximum of -15°C. represent the annual range. Differences between daily maximum and minimum temperature values increased from less than 5°C., monthly average figures from November to

February, to almost 10°C. in the period March to October. On two occasions in May the daily temperature range was 22°C.

Wind speed and direction, measured 10 m. above the snow surface. The prevailing wind was from the NE quadrant, Greenwich meridian being N. Monthly average wind speed was 3-5 meters per second from November to February, and between 5-9 mps for the remainder of the year. The highest wind speed, 23 mps, was recorded within a 24-hour period prior to the day when the average wind speed was 15 mps, maximum daily average for the year. Calm periods were rare.

Cloud cover. The cloud cover monthly averages ranged between 2/10 and 6/10. For December to March the cloud cover values were higher (5/10), than for the period April to November (3/10).

Independent of the sun ephemeris, the weather at Pole Station has a seasonal character which from a glaciological point of view can be divided as follows:

Winter: March to October
Transition (spring): Part of October and November
Summer: December and January
Transition (fall): February and part of March

Based on the above, the observer adopted a summer/winter seasonal status, both seasons extending between February and November.

The environment of each season, relative to each other, is distinguished by:

Summer (3-4 months): Low, stable temperature; dense cloud cover; low wind speed; dry.

Winter (8-9 months): Very low, wide temperature range; light cloud cover; high wind speed; very dry.

Note on radiation

Measurements of heat balance and ablation on temperate glaciers with flat surface about 3000 m. above sea level show that 80% of the energy responsible for ablation is supplied by absorption of short wave radiation from the sun and sky (3). Also due to the dry, dust-free air, the intensity of incident radiation at sea level in the Antarctic (at lat. 78°11'S) is as high as in the Alps at height of 3000 m. (4). However, polar glaciers have a particularly high albedo due to the dry powder snow at the surface (5), and, in addition, the low angle of incidence of the sun's radiation (6). The albedo values at PS in midsummer indicated that for the whole light season the albedo is as high as 90% (4). Also, it has been calculated that for lower latitudes with a clear sky the sun has to reach a height of 40° to make the radiation balance of the surface positive (7), but this is impossible at the Poles, although with considerable cloud cover the radiation balance of the surface becomes less negative (7). At PS the surface net radiation was measured as -34 langleys per day (8), even in January 1958, one of the two summer months when the height of the sun and the amount of cloud cover are most favorable to a positive radiation balance at the surface.

Processes Acting on the Surface

Processes acting on the surface described below do not necessarily produce any net change in mean surface level, i.e., deflation effective over one particular square meter is not necessarily effective over the whole general area, which may, in fact, show a net gain during the same period.

Generally speaking, at wind speeds above 5 mps, snow deposition and deflation will take place simultaneously over 1-2 m^2 elongated cuneiform patches oriented parallel to the wind direction. However, a net gain or loss can be measured after each high speed wind period.

Wind speed of 5 mps and more will cause the snow to drift, and a wind speed of 7-8 mps will noticeably deflate snow from soft layers. If the soft, low coherence stratum is at the surface, it will be deflated layer by layer; if it is covered by a relatively hard crust which is broken, a deflation pocket will form. In both cases deflation takes place to a depth great enough to yield the accumulation of the preceding season, providing that the high speed wind period persists for a sufficient length of time.

Besides the deposition and deflation patches and pockets, there are five other predominant surface features: linear sastrugi; anvil shaped corrasion forms; ridges at right angle and parallel to the wind direction; ripples; and very thin crusts with polished surfaces.

Linear sastrugi eventually go through the deposition-deflation process and, if winds rise above 10 mps, they will migrate. Anvil forms will be corraded on the windward side of deposition patches and recently formed sastrugi; the anvil horn of mature forms will break and sometimes a second anvil horn will be corraded. The wind turbulence, provoked by the anvil formation (usually 5-10 cm. high), will form a semicircular deflation area beneath the anvil's horn.

The thin crusts are not affected by deflation because the extreme smoothness of their surface does not allow the component grains to be easily dislodged by the impact of saltating particles. On the other hand, it seems that deposition is not favored either because grains will continue to roll over the surface which does not offer any degree of adherence. This latter situation cannot continue indefinitely, but some surface sections of crusts remained uncovered for weeks while snow accumulated all around.

Glaciological Observations in 1957

Snow accumulation from March to early November 1957 was "approximately one-half foot," as observed at four stakes (9). Distribution of this accumulation was irregular; e.g., ski tracks made in March were found uncovered after the winter months.

Precipitation consisted mainly of minute crystals. Visible flake-type precipitation was rare, occurring mostly in the summer and only seldom in winter.

Drifting snow occurred almost continuously.

Stratigraphic Observations, 1958

General

Preceding considerations on weather, surface features and snow accumulation were taken into account in the identification of seasonal and annual accumulation layers. Dating layers by stratigraphic characteristics is difficult when:

Snow has become homogeneous due to drifting and wind packing before deposition.

Seasonal layers are thin and irregularly deposited.

All layers are affected by sublimation.

Summer melting is negligible.

Oxygen-isotope ratios provide means of identifying annual accumulation layers where other methods fail (10). Samples were collected for oxygen-isotope studies and the results will be available in the near future. However, it should be pointed out that in the PS area the drifting snow is in part deflated from layers accumulated during the preceding season; therefore, any layer should have a considerable proportion of snow with an oxygen-isotope ratio characteristic of the preceding season, minimizing the ratio variation.

Fortunately, summer and winter weather and sun radiation conditions differed sharply. These contrasts produced qualitatively large changes in the snow cover and the strata were dated on the basis of these changes.

Stratigraphic observations were made in 18 pits to a maximum depth of 5.5 m., in the Snow Mine to a depth of 27 m., and in three auger-cores, one of which reached a depth of 50 m. The Snow Mine was excavated during 1957 (11).

Observations were not completed in all these pits and cores. Some of these pits were designated for specific purposes, e.g., sampling for filtering and geochemical studies, compaction rate measurements, etc.

The stratigraphy of a pit where thermohms were placed early in 1957 was observed on January 7, 1958. The walls were uncovered from 1 to 4 m.

of depth and were scraped inward 50 cm. to expose "fresh" firn. The firn was homogeneous in texture in these 3 m. and obviously represented several years of accumulation. As expected in such a high, cold, polar area, the firn was dry and there were no signs of appreciable melting and refreezing features. Individual layers ranged in thickness from less than 1 cm. to more than 20 cm., their boundaries being unevenly distributed in depth. Subtle differences in grain size, compactness, hardness, and coherence could be observed when comparing layers. Compaction and densification with depth were not readily evident as in subpolar areas.

Sublimation effects could be observed in all layers, more so immediately below iced crusts, where well developed sublimation crystals were formed.

In the Pole Station area sublimation is one of the keys to the understanding of the diagenesis of the upper layers of firn. A large annual temperature range, which at a depth of 50 cm. is approximately 35°C. (Fig. 28) subjects at least 2-3 annual accumulation layers to active sublimation that many times. Of course, the most active vapor transport and sublimation (vapor to solid phase) are expected to take place in the layer at the surface during each fall (12).

However, sublimation effects were observed in the layer accumulated throughout the winter of 1957, which by January 1958 had not yet been exposed to a fall season. This sublimation could be caused progressively by the air's daily temperature range of 10°C. or more recorded on more than 50 days during the winter of 1957. What is more important, in the same season there were several periods when throughout 2-6 days the air temperature would increase and decrease as much as 20° or 30°C., in both cases activating either phase of sublimation. It is believed that sublimation is subdued during these large temperature variation periods which occur in winter because the low temperatures at which the variations occur hamper molecular diffusion.

Detailed Studies

It was mentioned earlier that four stakes where snow accumulation was measured between March and early November 1957 showed approximately 15 cm. accumulation. The stakes were located windward of PS at 200 m. intervals, at distances ranging between 0.6 and 1.2 km. from the station. They were remeasured on January 9 and 10, 1958, and gave the following values:

Stake a:	12.5 cm.
b:	15.5
c:	21.0
d:	9.0

The average of 14.5 cm. is a figure well in accordance with the average value found in early November, and shows that snow accumulation during November and December 1957 was very small. Pits 60 to 90 cm. deep were dug near those stakes in order to observe the differences in firn metamorphism caused by the environment of each season, and based on these differences, to form the criteria to identify annual accumulation layers. Since all four pits offered a similar pattern of stratigraphic characteristics and sequence, pit "stake b" which has the snow accumulation value nearest to the average, is taken as a detailed example, Fig. 1 and Table 1.

FIGURE 1
PIT AT STAKE b, 9 JAN 1958

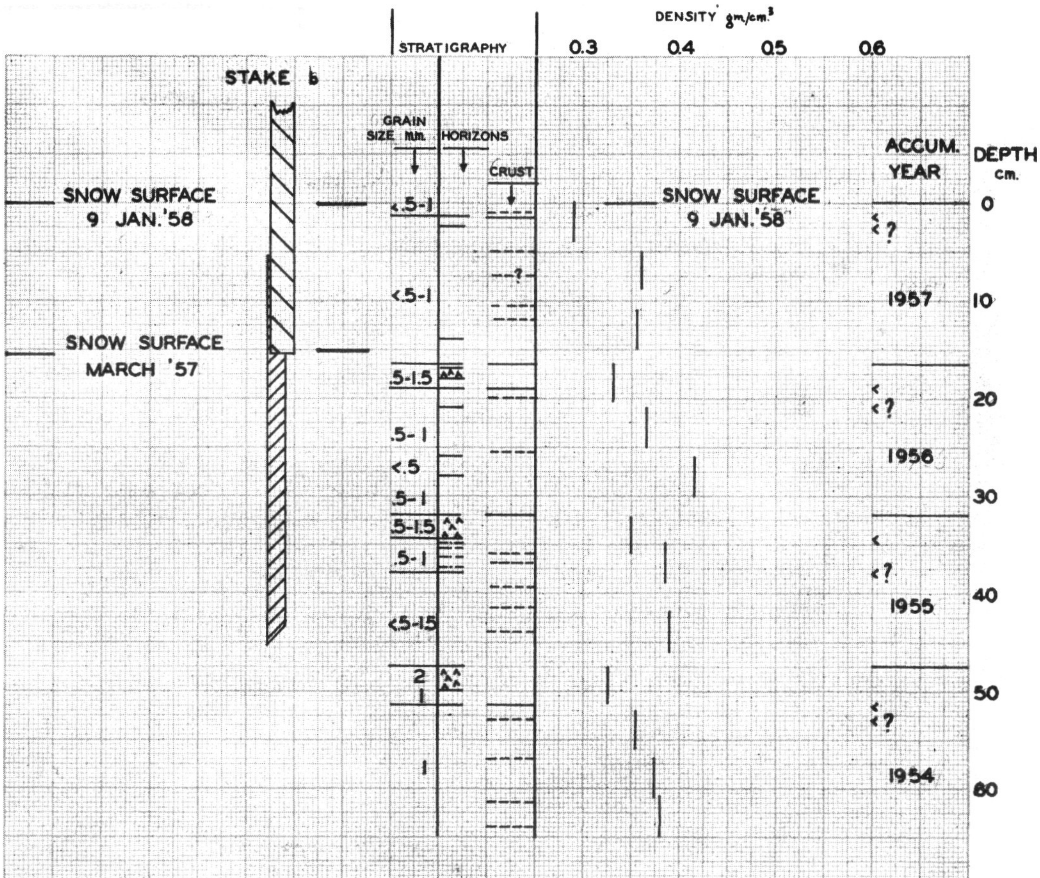


FIGURE 2
ACCUMULATION VALUES PIT AT STAKE b

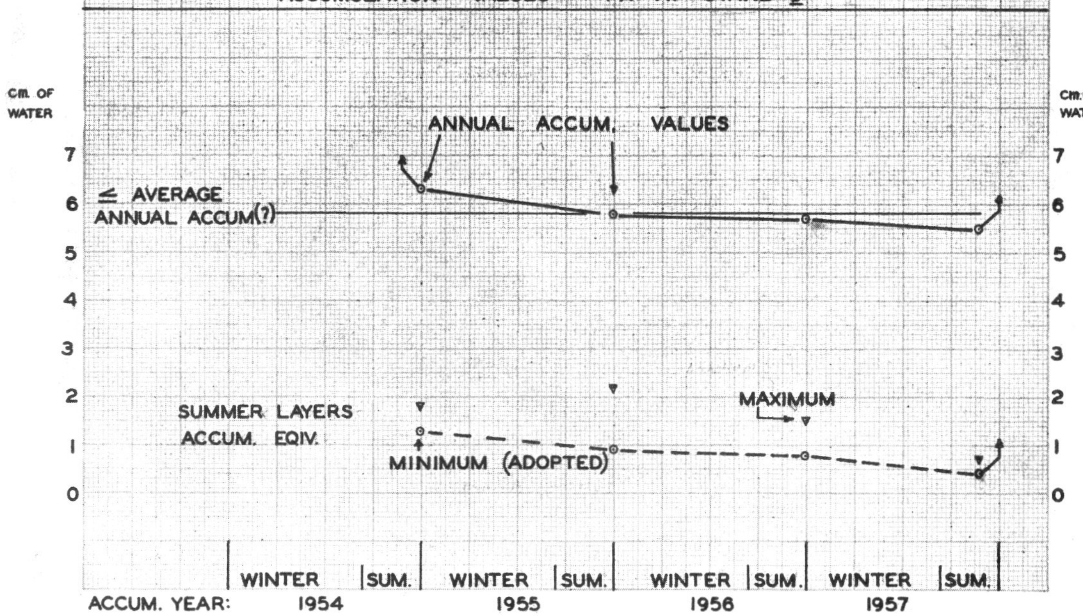


TABLE 1

Stratigraphy, Pit at Stake b; 9 January 1958

Depth cm.	Grain Size mm.	Remarks
0.0- 1.5	<.5-1.0	Soft; small clusters; upper 0.5 cm. is harder than the rest; there is more coherence between grains. Faint bonded-grain layer at depth of 1 cm.
1.5		Iced crust; <.5 mm. thick; grains are discernible.
1.5-16.5	<.5-1.0	Soft; some horizons are noticeable, but the layer is very homogeneous; at 1.5 - 2.5 and 14.0 - 16.5 cm. grain size range remains as indicated, but there is a higher proportion of large grains than in the rest of the layer; both zones are softer than 2.5 - 14.0 cm. Bonded-grain layers at depths of 5.0, 7.5 (faint), 10.5 and 12.0 cm.
16.5		Iced crust < .5 mm. thick; brittle; grains are discernible; the crust is not thicker than a single grain; there is no coherence between the crust and grains of the layer above.
16.5-19.0	.5-1.5	Very porous; very soft; grains have sharp edges; there is more coherence between grains and tighter clustering at 16.5 - 17.0 and 18.0 - 19.0 cm. than at 17.0 - 18.0 cm., where small sublimation crystals are visible.
19.0		Iced crust < .5 mm. thick; similar to others.
19.0-32.0	.5-1.0	Soft; very similar to the layer at 1.5 - 16.5 cm.; there are softer, larger grain size average zones at 19.0 - 21.0 cm. (sharp edged grains), and at 28.0 - 32.0 cm. (round grains). There is an intervening layer at 26.0 - 28.0 cm. where hardness increases, same as the proportion of small grains (some are .5 mm.); it is compact and medium hard. There are bonded-grain layers at 20.0 and 25.5 cm.
32.0		Iced crust < .5 mm. thick; brittle; similar to others.
32.0-34.5	.5-1.5	Soft; porous; some 2 mm. sublimation crystals break the otherwise uniform grain size range; large grains have sharper edges than the small grains.
34.5-38.0	.5-1.0	Medium hard; more compact than the layer above; grains are round. Well defined bonded-grain layers at 36.0 and 37.0 cm. Faint horizons about every .5 cm. show that this layer was accumulated in laminae.
38.0-47.5	<.5-1.5	Gradually compacting with depth, this layer is soft at the top, hard at the bottom; grain size range is the same throughout this layer, with proportion of large grains decreasing toward bottom. There are bonded-grain layers at 39.5, 41.5 and 44.0 cm.

TABLE 1
(Continued)

Depth cm.	Grain Size mm.	Remarks
47.5-51.5	1.0-2.0	Very soft; large air spaces; there are clusters of sublimation crystals (2 mm.) from 47.5 to 50.0 cm.; below this depth sharp edged 1 mm. grains are present. The 47.5 horizon is sharp.
51.5		Iced crust .5 mm; similar to others.
51.5 and below	1.0	Soft in the upper 2.0 - 3.0 cm.; hardness increases gradually with depth to 65.0 cm., bottom of the pit. Bonded-grain layers at 53.0, 57.0, 61.5 and 64.0 cm.; these are more easy to observe than similar layers near the surface because the adherence of sublimation at their low surfaces has almost doubled their "original" thickness. The same applies to the iced crusts.

Because of the stake b placement data and snow accumulation measurements, it is known that the strata from the surface to a depth of 15.5 cm. at least, if one is to allow for negligible compaction, was deposited since March 1957; that is to say, the strata to that depth accumulated from late in the fall or early in the winter 1957, through the winter and past the spring, and at the time of observation, the surface was exposed to the mid-summer weather. Immediately below the base of stake b should lay the strata accumulated early in/or during the fall of 1957, and below this, that which accumulated or was exposed during the summer 1956-57.

13

Considering dating procedures used heretofore, principally those advocated by the Snow, Ice and Permafrost Research Establishment, procedures with which the author became familiar in North Greenland in 1956 (15), it was thought that the sequence of stratigraphic characteristics observed in pits a to d could be used tentatively to determine criteria for identification of annual accumulation layers in PS area. The criteria are as follows:

Winter layers are of small grain size range and average; are relatively compact and hard, often contain several very thin wind-crusts (a), and wind-packed layers (b); winter layers are of relatively high density.

Summer layers are of relatively large grain size range and average; are soft, and the formation of loose clusters of low coherence between grains is general; these layers contain thin radiation crusts (c), and wind crusts; below these crusts sublimation crystals and/or other signs of considerable sublimation are observed after the fall period; summer layers have low density values.

At this point it is necessary to explain the use of nomenclature such as: (a) Wind crusts: noted in stratigraphy observations as bonded-grain layers. They are of aggregate structure and apparently the bonding agent is sublimation. They are found in summer and winter layers, and were observed in the winter layer of 1957, which at the time of observations had not been exposed as yet to the fall period. On page 6 of this report it was stated that sublimation was active through the winter; it should be added now that the periods of large temperature increase (1-3 days) are recorded simultaneously with high speed winds (10-15 mps). These periods are followed generally by a sharp decrease in temperature which subjects the surface layer to a pronounced inversion, favorable for sublimation. The writer believes that the bonded-grain layers consolidate by sublimation adherence to the base of the surface laminae, whose component grains have been initially compacted by saltating drift particles; hence, the bonded-grain layers are related to wind.

(b) Wind-packed layers: e.g., at depth of 26-28 cm. Their continuity and moderate compaction differentiate them from sastrugi.

(c) Radiation crusts: insolation or sun crusts; noted in stratigraphic description as iced crusts. The grains forming these crusts are cemented; and, when observed in plane section, they are more translucent than those of average firn. That they form in summer is definite, but how they form is not known by the writer.

While Lilequist has asserted that ice-crusts may form below the surface with the air temperature just below freezing (16), at PS a maximum temperature well below freezing has to be considered. More likely the origin of these iced crusts could be attributed to Shoumsky's viewpoint on the subject 15 (17). Further study is required of all factors involved in internal melting through individual "insolation" or properly oriented crystals composing grains at the surface.

SIPRE methods of observation and derived conclusions used in Greenland were followed, somewhat revised by the writer because of the different stratigraphic factors encountered in several observation points, at the coast on the Ross Ice Shelf and in the interior of West Antarctica 1500 m. above sea level.

Quantitatively the winter seemed to account for most of the annual accumulation, whereas summer conditioning offered more reliable characteristics so far as dating is concerned.

Seasonal boundaries within an annual layer are produced each spring and fall. The latter, between the late summer recrystallized firn and the early winter massive accumulation, is always found to be the most distinctive horizon. Therefore, the adopted limit for an annual accumulation layer extends from fall to fall, as opposed to a calendar year.

However sharp this horizon may be, it is still difficult to place it with absolute accuracy; the pronounced temperature inversion produced by the fall period increased interlayer mass migration and sublimation (vapor to solid), processes which together with the dissipation of latent heat from the upper layers homogenize the very last summer deposition, e.g., 0.5 cm. of snow covering a radiation crust and the first 1-2 cm. of winter deposition, originating zones like those described in pit b at 14-16.5 cm. and 28-32 cm. of depth. Somewhere in these zones is the true limiting horizon. To avoid hypothetical errors, outstanding radiation crusts or distinct horizons like the one at a depth of 47.5 cm. are used in this and the following pits.

In all, the stratigraphic description of pits a to d offered good correlation between the seasons' weather and accumulation environments, mainly in obvious aspects such as: radiation crusts in summer layers; considerable sublimation in layers exposed at or near the surface during each fall; thinly layered, wind-packed layers in strata accumulated during the winter, the windiest season.

Annual water accumulation values computed from pit b, Table 2, are plotted schematically against time on Fig. 2. There the two possible extreme values for the summer accumulation are given to evaluate the possible seasonal ratio within the annual accumulation. Yet these values are not absolute since a winter layer exposed at or near the surface during a summer will respond to its environment, and later taken for summer accumulation.

TABLE 2

Annual Accumulation Values, Pit b

Depth cm.	Accum. Year	Cm. of Snow	Avg. Density gm/cm³	Annual Accum. Cm. of Water
0.0-16.5	1957	≥16.5	.335	≥5.5
16.5-32.0	1956	15.5	.370	5.7
32.0-47.5	1955	15.5	.375	5.8
47.5-65.0	1954	≥17.5	.359	≥6.3
			Annual Average	≥5.8

Snow pit studies at stakes a to b showed that annual accumulation layers 15-20 cm. thick were common. Particular layers were irregularly distributed in depth and their thickness was variable. Considering that the snow surface in itself was very irregular, with differential height values greater than the thickness of annual layers (at least in each 30-40 m^2), it was decided to study the stratigraphy in such a manner that the average of annual accumulation values would be representative.

To secure correlation between the different sets of observations it was necessary to follow individual layers from pit to pit. Also, in order to cover a stratigraphic section representative of the distribution of a given layer, it was advisable to set pit studies continuously, if possible, along a 10-15 m. line perpendicular to the direction of prevailing winds, since, in general, surface features extend parallel to the wind direction.

Pits #1 to #5. 31 January - 12 February

Five pit studies were made 3 m. apart, along a line oriented perpendicular to the direction of prevailing winds. Each pit was dug with a "principal" observation wall (NE) 1.5 m. wide adjacent to the line mentioned above; the lateral walls varied in length according to the depth of the pit.

The depth-controlled observations were made in the pits in stratigraphic columns not larger than 600 cm^2 to secure in the recorded data a true relation between, e.g., rammsonde (16) and density values. However, the characteristics of each layer were observed along the four pit walls; and, at the end of standard observations in a pit (17), these layers were visually identified according to their seasonal characteristics.

The data from each pit were then plotted and studied, and the strata were identified by seasons, i.e., summer and winter. Disagreements on the identification of seasonal layers between the identification done in the field, and that of the study of the recorded observations, were resolved by more detailed consideration of the layers in question.

Later the five pits were linked by means of key layers, which were physically followed at low levels from pit to pit, digging across the 1.5 m.

sections separating pits #4 and #5, and driving markers through thick, homogeneous layers to link pits #1 to #4.

The single sets of observations were then considered as a whole and any differences in interpretation were rechecked in the pits. The usual misinterpretations were: summer layers inclosed by highly metamorphosed winter layers, which were not recorded as a summer (error: -1 year); or wind-packed layers within summer layers, which were recorded as a winter (error: +1 year). In either case the error introduced in the total count of the strata was increased by 1 year. In shallow pits these ± values do not necessarily eliminate each other.

In the following figures and tables the given pit studies are schematically presented. Figures 3, 4, and 5 represent pits #1, #2, and #3, respectively. The dating of the strata is given as corrected by correlation. Figures 6 and 7 represent pit studies #4 and #5, complemented by stratigraphic features, which are described in Table 3 and 4.

In Fig. 8 the annual accumulation values of pits #1 to #5 are presented individually, and in average; the computations to obtain the individual annual accumulation values are given in Table 5 to 9, and those to obtain the average values are given in Table 10.

FIGURE 3
PIT I, 2 FEB 1958

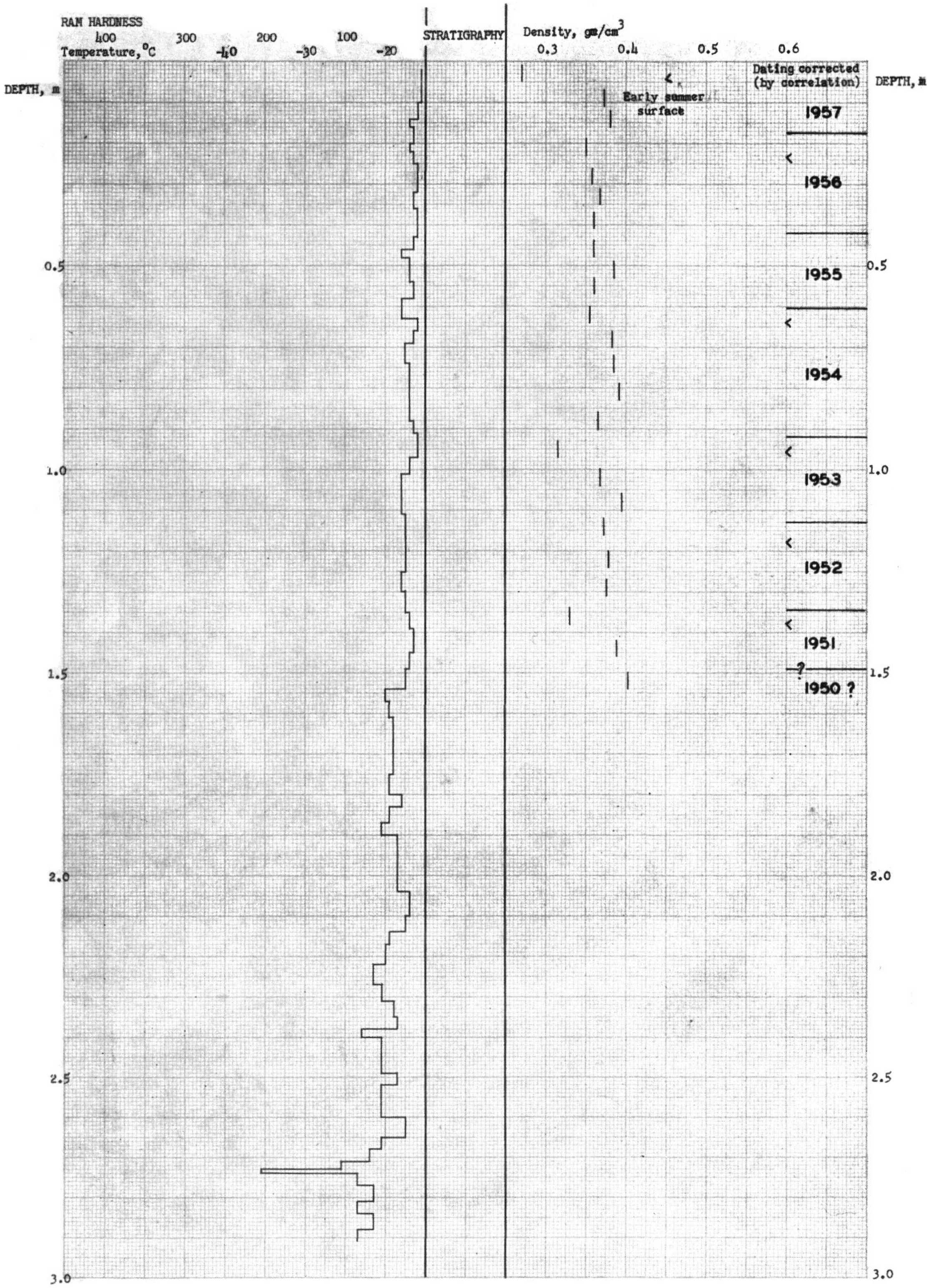


FIGURE 4

PIT 2 ; 3 FEB 1958

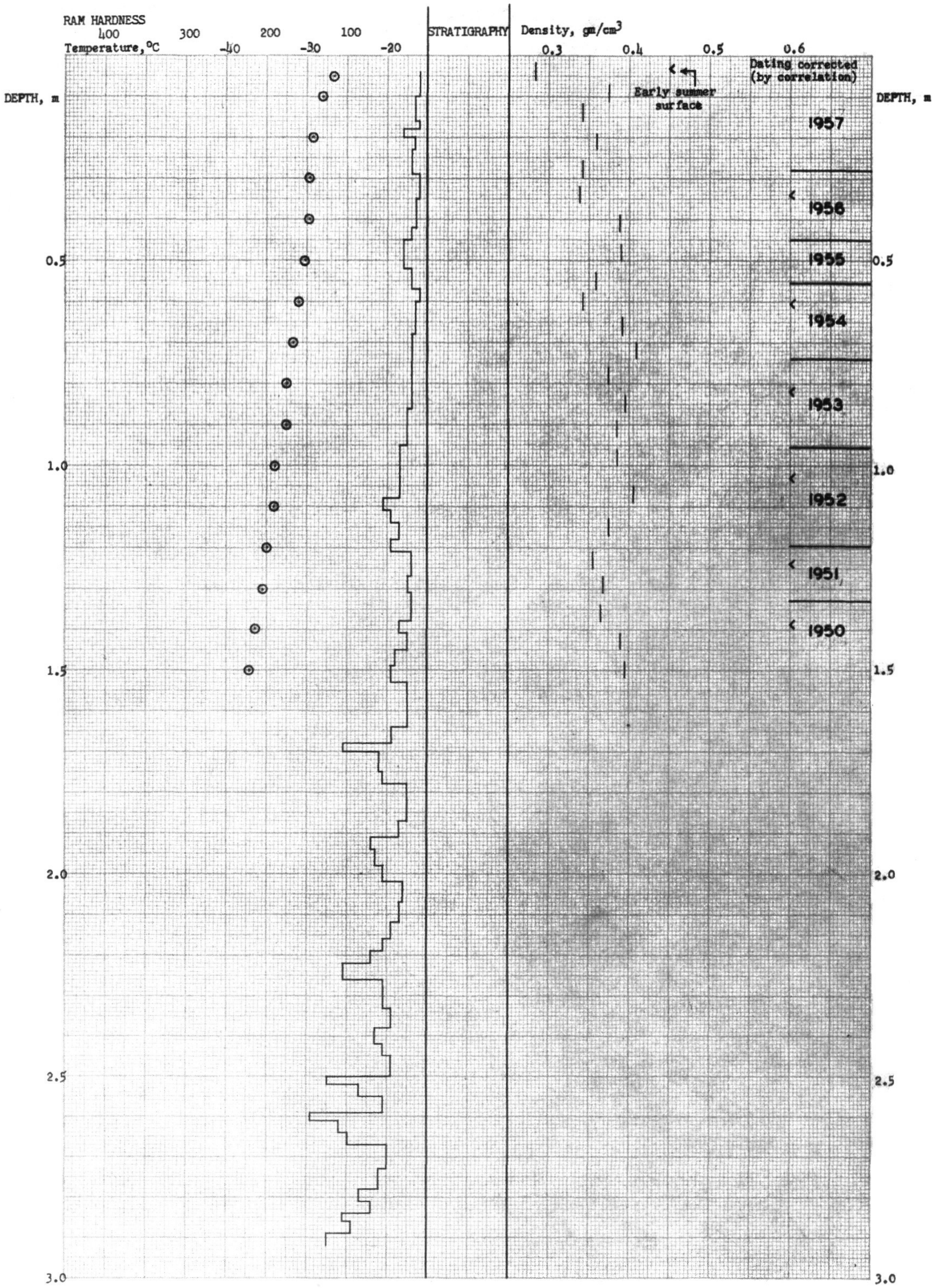


FIGURE 5

PIT 3, 3 FEB 1958

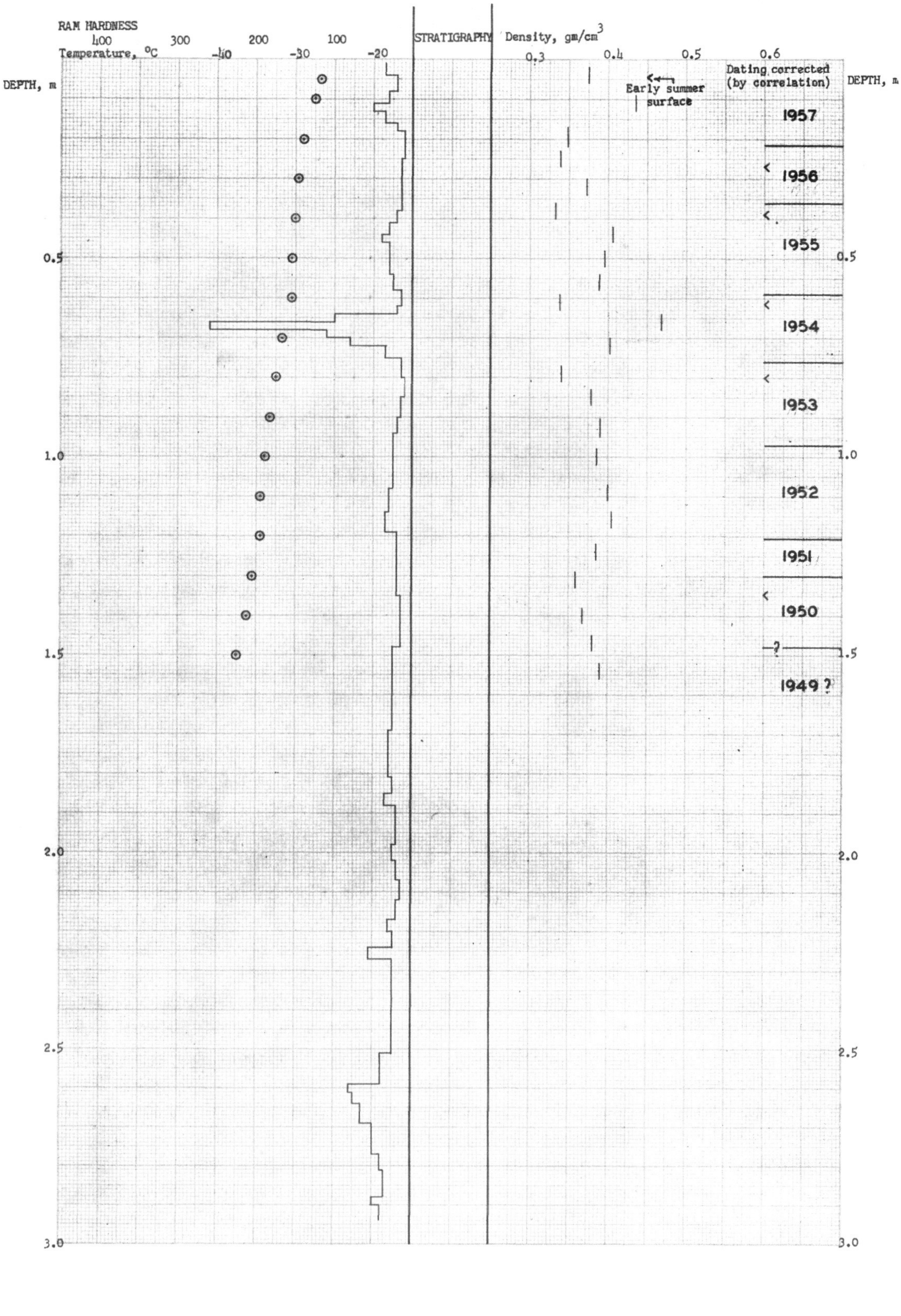


FIGURE 6

PIT 4 ; 4 FEB 1958

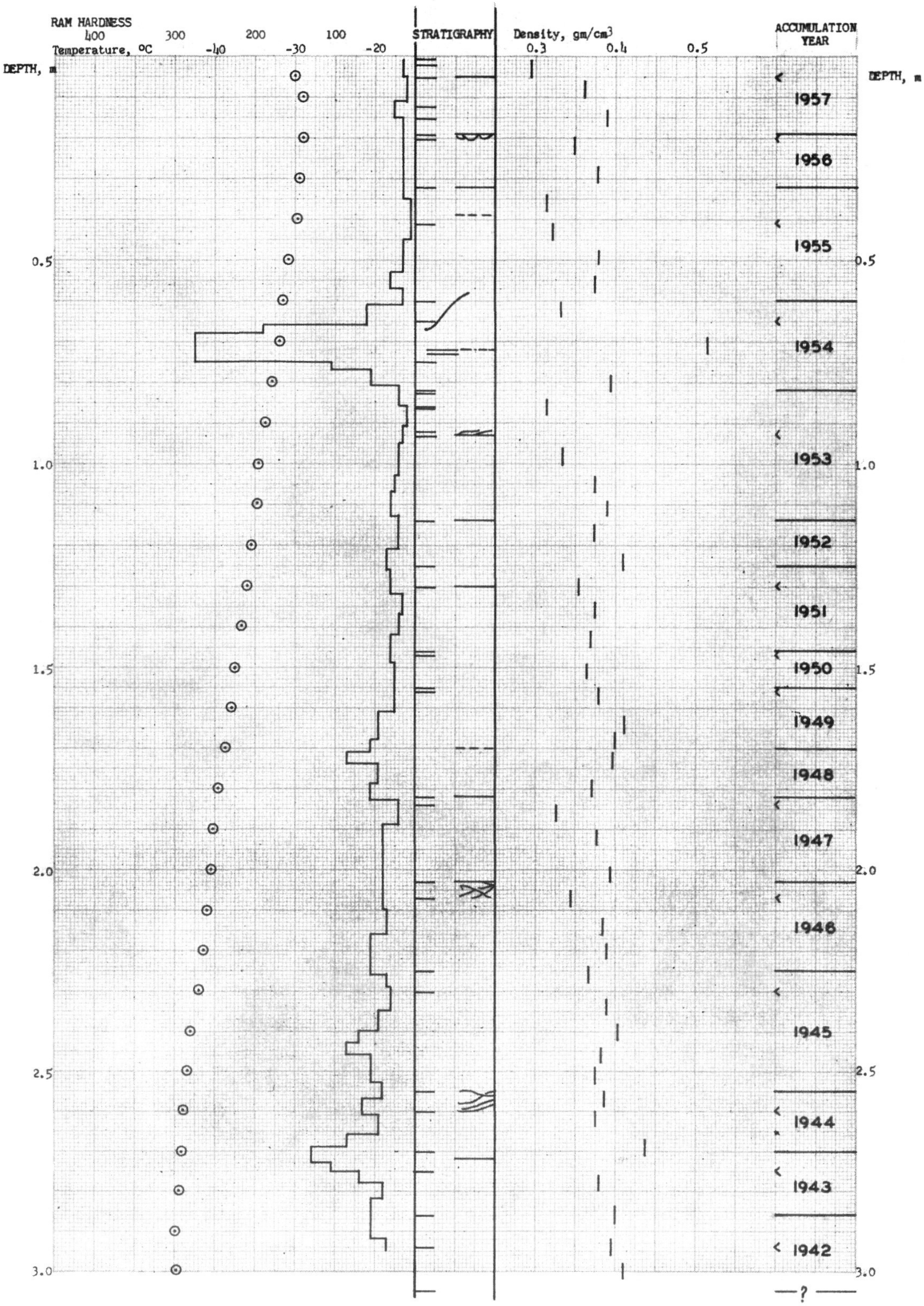


TABLE 3

Stratigraphy, Pit #4; 4 February 1958

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
0.0- 0.5		.25-1.0		Soft; there is no coherence between grains; grains are round.
0.5- 2.0		.25-0.75		Wind packed snow; round grains; medium hard.
2.0- 5.0		.75	0.5	Round grains; clusters.
5.0				Iced crust 1.0 mm. thick; its bottom surface is minutely jagged.
5.0- 12.0		.5 -0.75	0.4	Irregular grains; clusters.
12.0- 15.0		<.25-1.0	0.6	Wind packed snow; medium hard.
15.0- 19.0	W 1957	.25-0.75	0.5	Clusters; round grains.
19.0	S			Iced crust 1.0 mm. thick; it divides in 2-3 crusts of the same thickness, forming cells from 19-20 cm.
19.0- 20.0		.5 -1.25		Irregularly distributed, this layer is 5 cm. thick in other walls of the pit; sublimation crystals in some cells reach 1.5 mm. in size; loose clusters.
20.0- 32.0	W 1956	.25-1.0	0.4- 0.7	Round grains.
32.0	S			Iced crust 1.0 mm. thick; similar to that at 19 cm.; this one also divides in 2-3 layer .25-.5 mm. thick.
32.0- 41.0		.75-1.25	0.3	Irregular grains.
39.0				Bonded grain layer .75 mm. thick.
41.0- 60.0	W 1955	1.0	Top 0.4 Mid 0.5 Bot 0.7	Clusters; hardness increases from top to bottom.
60.0- 65.0		<.25	30.0-35.0	This layer varies in thickness between 2 and 5 cm.; its bedding plane has undulations which vary in depth from 58 to 67 cm. This layer is not found in other walls of the pit.
60.0- 65.0	S	.75-1.5	0.3	Clusters; round grains at the bottom; sharp edged grains at the top; very loose clusters indicate sublimation.

TABLE 3
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
65.0- 75.0		<.25	80.0	In other walls of the pit this layer is divided by a discontinuous horizon at 72 cm. of depth.
72.0- 73.0		.25-1.25	0.5- 0.8	This layer is discontinuous and appears intervening the layer described above.
75.0- 82.0	W 1954	1.0	0.7	There is a decrease in grain size (to .75 mm.) toward the top.
82.0- 82.5	S	2.0 -3.0	0.2	Sublimation crystals; loose clusters.
82.5- 86.0		1.25	0.3	Clusters; irregular grains.
86.0- 86.5		2.0 -3.0	0.2	Sublimation crystals; loose clusters; in the strata from 82 to 86.5 cm. there are no distinct horizons.
86.5- 93.0		1.0 -1.25	0.4	Some clusters.
93.0				Iced crust .5 mm. thick; it divides in two layers forming cells between 92-93 cm. where sublimation crystals 2 mm. in size are observed.
93.0-114.0	W 1953	.5 -1.5	Top 0.3 Mid 0.4 Mid 0.7 Bot 0.5	Grain size decreased and hardness increases from top to bottom; these trends reversed below a depth of 110 cm.
114.0	S			Iced crust 1.0 mm. thick.
114.0-125.0	W 1952	.5 -1.0	0.6- 0.7	Compact.
125.0-130.0	S	.5 -1.0	0.5	Clusters.
130.0				Iced crust 1.0 mm. thick
130.0-146.0	W 1951	.75-2.0	0.6- 0.9	Hardness and grain size vary throughout the layer.
146.0-147.0	S	1.0 -2.0	0.5	Sharp edge grains; loose.
147.0-155.0	W 1950	1.0	0.7	Round grains.
155.0-156.0	S	1.0 -2.0	0.5	Sharp edge grains; clusters.
156.0-170.0	W 1949	.5 -1.0	1.0	Homogeneous layer.
170.0	S			Iced crust .25 mm. thick.
170.0-182.0	W 1948	.5 -1.0	1.0	Homogeneous layer.
182.0	S			Iced crust 1.0 mm. thick.
182.0-184.0		1.0 -1.25	0.4	Considerable sublimation; some broken sublimation crystals are noticeable.

TABLE 3
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
184.0-203.0	W 1947	.25-1.25	0.9- 1.5	Homogeneous layer; round grains.
203.0	S		0.3	Iced crust .5 to .75 thick; it divides forming cells down to 207 cm. of depth; in these cells 1.5 mm. sublimation crystals are observed.
207.0-225.0	W 1946	.25-1.0	0.5- 0.9	Large grains are more abundant at the top; hardness increases toward bottom.
225.0-230.0	S	1.0 -1.25	0.9	Irregular grains; well compacted layer.
230.0-255.0	W 1945	.25-1.0	Top 0.9 Mid 0.3 Bot 0.5	Grain size increases toward bottom and hardness decreases, both trends reversed at about 240-245 cm.
255.0-260.0	S	.25-0.75		Several iced crusts; they all divide in two or three layers forming cells; 1-2 mm. sublimation crystals form clusters (hardness: .2).
260.0-270.0	W 1944	.5 -2.0	6.0	Compact; round grains; this layer is divided.
270.0-275.0	S	.75-2.0	2.5	Irregular grains.
272.0				Iced crust 1.0 mm. thick.
275.0-286.0	W 1943	.5 -1.25	3.0- 4.5	Round grains.
286.0-294.0	S	.75-1.5	2.5	Irregular grains.
294.0-305.0		.5 -1.0	3.0- 5.0	Irregular grains.
Below 305.0	W '42	.25-0.5	7.5	Round grains; compact; the horizon at 305 cm. of depth is sharp; the texture of this layer indicates it was compacted by wind when at the surface.

FIGURE 7

PIT 5, 8 FEB 1958

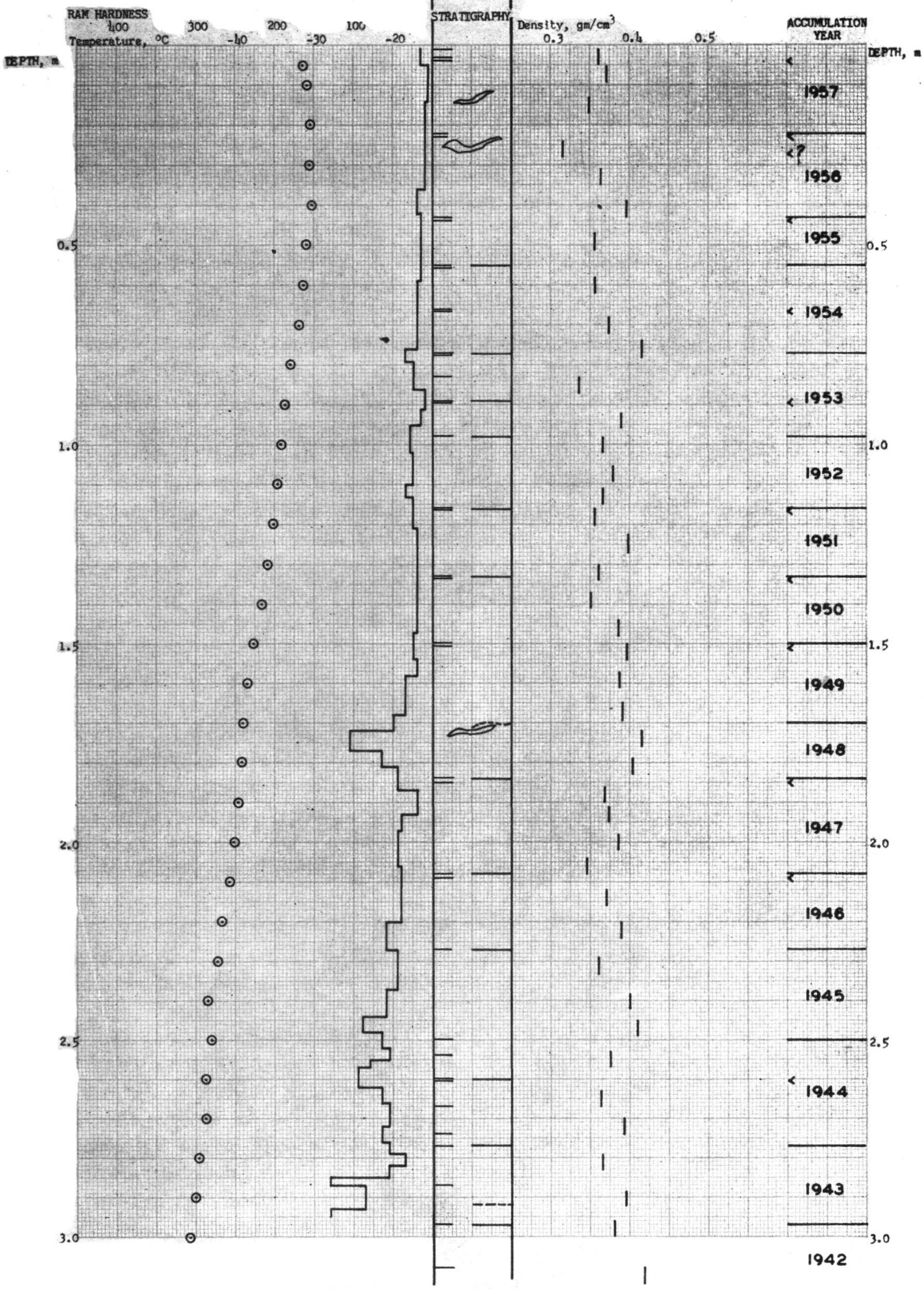


TABLE 4

Stratigraphy, Pit #5; 8 February 1958

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
0.0- 1.0		.5	Soft	Round grains.
1.0- 3.0		<.5	Med. hard	Wind compacted snow; round grains.
3.0- 4.0		.75	Very soft	Round grains; loose clusters.
4.0- 22.0	W 1957	.25-1.0	Med. hard	This layer is intruded at 12-15 cm. by a discontinuous, hard layer, grain size < .25 mm.; it is irregularly distributed in depth and has a chalk-like appearance.
22.0- 22.5	S	.75-1.25	Soft	Sublimation crystals (1.25 mm.); sublimation effects observed in small grains (.75 mm.).
23.0- 27.0		<.25-0.5	Very hard	Discontinuous; irregularly distributed in depth; wind packed when at the surface.
22.5- 43.0	W 1956	.25-1.0	Med. hard	Compactness and hardness increase below 35 cm.
43.0- 43.5	S	1.0 -1.25	Soft	Some sublimation crystals; clusters.
43.5- 55.0	W 1955	.75-1.25	Med. hard	Variable distribution of grain size and hardness values.
55.0	S			Iced crust .5 mm. thick.
55.0- 55.5		1.0 -1.25	Soft	Some sublimation crystals; clusters.
55.5- 66.0		.5 -1.0	Med. hard	Round grains; clusters.
66.0- 66.5		1.5 -2.0	Very soft	Sublimation crystals; loose clusters.
66.5- 77.0	W 1954	.25-1.25	Med. hard	Round grains, but some sharp edges are observed.
77.0	S			Iced crust .5 mm. thick.
77.0- 77.5		1.75-2.0	Very soft	Well defined sublimation crystals; loose clusters; large air spaces.
77.5- 83.0		.5 -1.25	Med. hard	Irregular grains.
83.0				Iced crust .5 mm. thick; it divides in two thinning layers.
83.0- 89.0		.5 -1.25	Soft	Irregular grains.
89.0				Iced crust .5 mm. thick.
89.0- 89.5		.75-2.0	Very soft	Sublimation crystals; some are broken.

TABLE 4
(Continued)

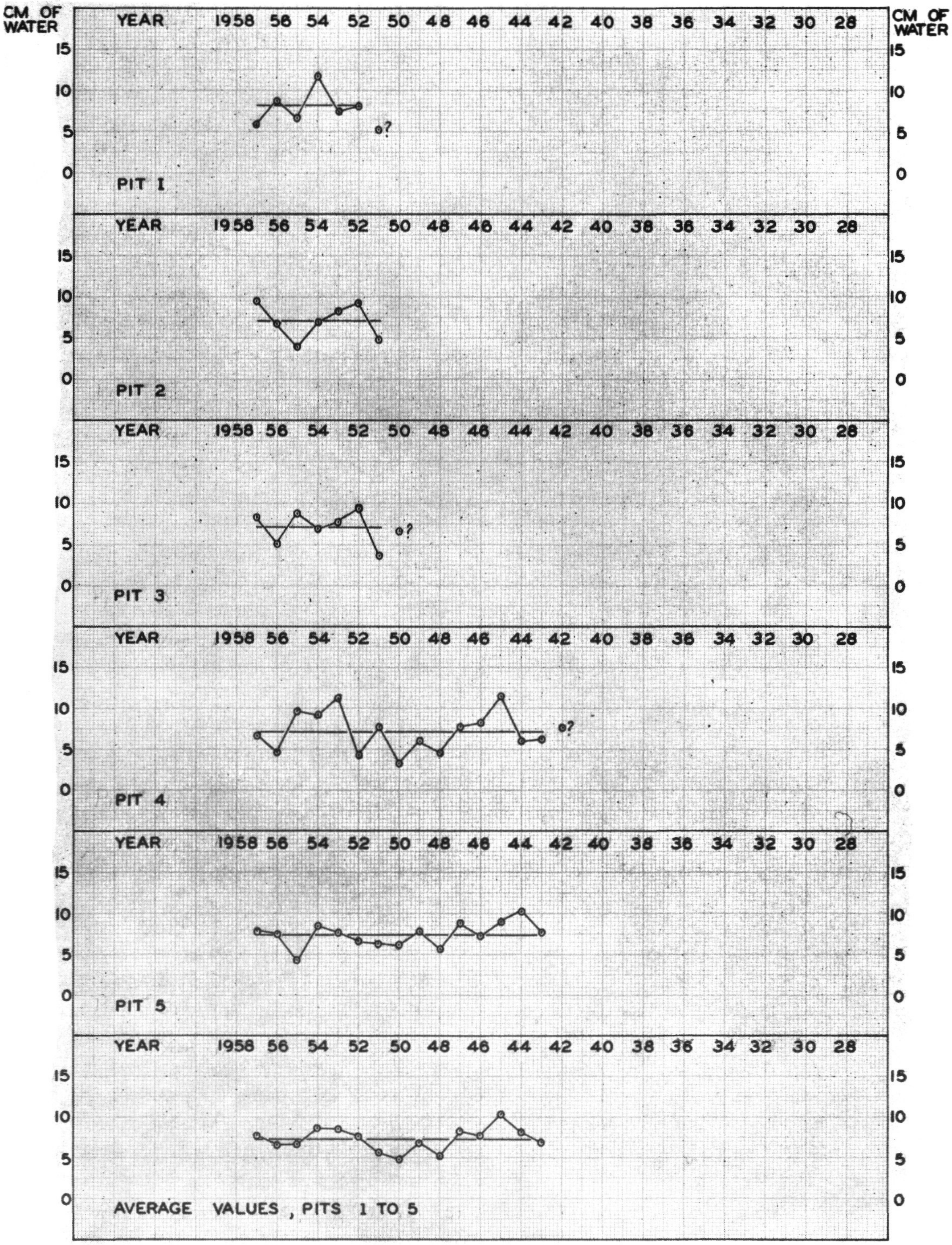
Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
89.5- 98.0	W 1953	1.0	Med. hard	Compaction increases toward the bottom.
98.0	S			Iced crust .75 mm. thick.
98.0-116.0	W 1952	.75-1.0	Med. hard	Round grains.
116.0	S			Iced crust .5 mm. thick.
116.0-116.5		1.5	Soft	Sublimation crystals and sharp edged grains; clusters.
116.5-133.0	W 1951	1.0	Med. hard	There is a hard zone in the middle of this layer.
133.0	S			Iced crust .5 mm. thick.
133.0-133.5		1.0 -2.0	Soft	Irregular grains and sublimation crystals.
133.5-150.0	W 1950	1.0	Med. hard	Compaction increases toward the bottom.
150.0-151.0	S	1.0 -3.0	Soft	Sublimation crystals; loose clusters; large air spaces.
151.0-184.0	W 1949 W 1948	.5 -1.25	Med. hard	Compact; this homogeneous layer is divided at 170-174 cm. by a discontinuous layer where the component grains are small, the upper surface of this intervening layer is marked by a bonded grain laminae.
170.0	S			Bonded grain layer .5 mm. thick.
184.0	S			Iced crust .75 mm. thick.
184.0-185.0		.75-3.0	Very soft	Sublimation crystals, loose clusters.
185.0-208.0	W 1947	.75-1.0	Med. hard	This homogeneous layer is divided by a distinct horizon.
208.0	S			Iced crust 1.0 mm. thick.
208.0-209.0		1.0 -3.0	Very soft	Sublimation crystals; loose clusters; large air spaces.
209.0-227.0	W 1946	.75-1.25	Med. hard	Rounded grains; horizons at 224 and 217 cm. of depth.
227.0	S			Iced crust 1.0 mm. thick.
227.0-250.0	W 1945	.75-1.25	Med. hard	Compaction increases toward the bottom.
250.0-254.0	S	1.0 -1.5	Soft	Loose clusters; irregular, sharp edged grains.
254.0-260.0		.75-1.25	Med. hard	Compaction increases toward the bottom.
260.0				Iced crust .5 mm. thick.

TABLE 4
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
260.0-260.5		1.0 -2.5	Soft	Sublimation crystals; clusters.
260.5-277.0				This layer has three zones; the characteristics of one are found in the other two.
260.5-267.0		1.25	Soft	Sharp edged grains.
267.0-274.0		.75	Med. hard	Irregular grains.
274.0-277.0	W 1944	.25	Hard	Round grains.
277.0	S			Iced crust .75 mm. thick.
277.0-287.0		1.0 -2.0	Med. hard	Compaction increases toward the bottom while grain size decreases; round grains.
287.0-297.0	W 1943	.5 -1.0	Med. hard	The bottom surface is irregularly distributed in depth.
292.0				Bonded grain layer .5 mm. thick.
297.0	S			Iced crust .75 mm. thick.
297.0-308.0		.75-1.5	Hard	There is a large proportion of irregular grains at the top and at the bottom of this layer. Both upper and lower boundaries are uneven.
308.0 and below	W '42	.75-1.0	Hard	This layer is more compact than the layer above.

FIGURE 8

ANNUAL ACCUMULATION VALUES, IN WATER EQUIVALENT



ACCUMULATION DATA

TABLE 5

Pit #1, 2 February 1958

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	17.5	17.5	.341	6.0	6.0	6.0
1956	2	17.5	42.0	24.5	.359	8.8	14.8	7.4
1955	3	42.0	60.5	18.5	.368	6.8	21.6	7.2
1954	4	60.5	92.0	31.5	.374	11.8	33.4	8.4
1953	5	92.0	113.0	21.0	.359	7.5	40.9	8.2
1952	6	113.0	134.5	21.5	.375	8.1	49.0	8.2
1951	7	134.5	149.5(?)	14.5	.359	5.2	54.2	7.7
1950(?)	8	149.5						

TABLE 6

Pit #2, 3 February 1958

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	28.0	28.0	.340	9.5	9.5	9.5
1956	2	28.0	45.0	17.0	.398	6.8	16.3	8.2
1955	3	45.0	55.5	10.5	.374	3.9	20.2	6.7
1954	4	55.5	74.0	18.5	.381	7.0	27.2	6.8
1953	5	74.0	95.5	21.5	.385	8.3	35.5	7.1
1952	6	95.5	119.5	24.0	.389	9.3	44.8	7.5
1951	7	119.5	133.0	13.5	.361	4.9	49.7	7.1
1950	8	133.0						

TABLE 7

Pit #3, 3 February 1958

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	21.5	21.5	.387	8.3	8.3	8.3
1956	2	21.5	36.0	14.5	.355	5.1	13.4	6.7
1955	3	36.0	59.0	23.0	.381	8.8	22.2	7.4
1954	4	59.0	76.0	17.0	.403	6.9	29.1	7.3
1953	5	76.0	97.0	21.0	.369	7.7	36.8	7.4
1952	6	97.0	120.5	23.5	.397	9.3	46.1	7.7
1951	7	120.5	130.0	9.5	.384	3.6	49.7	7.1
1950	8	130.0	148.0(?)	18.0	.369	6.6	56.3	8.0
1949(?)	9	148.0						

TABLE 8

Pit #4, 4 February 1958

Accumulation Year	Year No.	Top* cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	19.0	19.0	.349	6.6	6.6	6.6
1956	2		32.0	13.0	.364	4.7	11.3	5.7
1955	3		60.0	28.0	.348	9.7	21.0	7.0
1954	4		82.0	22.0	.414	9.1	30.1	7.5
1953	5		114.0	32.0	.349	11.2	41.3	8.5
1952	6		125.0	11.0	.393	4.3	45.6	7.6
1951	7		146.0	21.0	.367	7.7	53.3	7.6
1950	8		155.0	9.0	.366	3.3	56.6	8.1
1949	9		170.0	15.0	.397	6.0	62.6	7.0
1948	10		182.0	12.0	.385	4.6	67.2	6.7
1947	11		203.0	21.0	.367	7.7	74.9	6.8
1946	12		225.0	22.0	.374	8.2	83.1	6.9
1945	13		255.0	30.0	.383	11.5	94.6	7.3
1944	14		270.0	15.0	.400	6.0	100.6	7.2
1943	15		286.0	16.0	.387	6.2	106.8	7.1
1942	16		305.0(?)	19.0	.402	7.6	114.4	7.2

*Top of layer same as bottom of preceding annual layer.

TABLE 9

Pit #5, 8 February 1958

Accumulation Year	Year No.	Top* cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	22.0	22.0	.359	7.9	7.9	7.9
1956	2		43.0	21.0	.357	7.5	15.4	7.7
1955	3		55.0	12.0	.354	4.2	19.6	6.5
1954	4		77.0	22.0	.381	8.4	28.0	7.0
1953	5		98.0	21.0	.361	7.6	35.6	7.1
1952	6		116.0	18.0	.369	6.6	42.2	7.0
1951	7		133.0	17.0	.371	6.3	48.5	6.9
1950	8		150.0	17.0	.367	6.2	54.7	6.8
1949	9		170.0	20.0	.390	7.8	62.5	6.9
1948	10		184.0	14.0	.409	5.7	68.2	6.8
1947	11		208.0	24.0	.367	8.8	77.0	7.0
1946	12		227.0	19.0	.379	7.2	84.2	7.0
1945	13		250.0	23.0	.390	9.0	93.2	7.2
1944	14		277.0	27.0	.377	10.2	103.4	7.4
1943	15		297.0	20.0	.380	7.6	111.0	7.4
1942	16							

TABLE 10

Average Accumulation for Pits #1 to #5

Accum. Year	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Annual Average	Total	Mean Accum. from Year 1
1957	6.0	9.5	8.3	6.6	7.9	7.7	7.7	7.7
1956	8.8	6.8	5.1	4.7	7.5	6.6	14.3	7.2
1955	6.8	3.9	8.8	9.7	4.2	6.7	21.0	7.0
1954	11.8	7.0	6.9	9.1	8.4	8.6	29.6	7.4
1953	7.5	8.3	7.7	11.2	7.6	8.5	38.1	7.6
1952	8.1	9.3	9.3	4.3	6.6	7.5	45.6	7.6
1951		4.9	3.6	7.7	6.3	5.6	51.2	7.3
1950				3.3	6.2	4.8	56.0	8.0
1949				6.0	7.8	6.9	62.9	7.0
1948				4.6	5.7	5.2	68.1	6.8
1947				7.7	8.8	8.3	76.4	6.9
1946				8.2	7.2	7.7	84.1	7.0
1945				11.5	9.0	10.3	94.4	7.3
1944				6.0	10.2	8.1	102.5	7.3
1943				6.2	7.6	6.9	109.4	7.3

*Top of layer same as bottom of preceding annual layer.

Pits #6, #7 and #8. 13 February - 11 March

A trench 3 m. wide was opened, with the help of a tractor, to a depth of 3 m. In the side walls three vertical sections were uncovered, approximately 1 m. inside the walls and 5 m. apart. The procedures of observations were the same as in Pits #1 to #5, the only difference being that, in this case, the columns under study were correlated directly, following layers along the walls.

Figures 9 and 10 illustrate Pits #6 and #7. Figures 11, 12, and 13 illustrate Pit #8; the stratigraphic description of Pit #8 is given in Table 11.

Annual accumulation values obtained from observations in Pits #6 to #8 are computed in Tables 12 to 14, and their averages are found in Table 15; these values are plotted in Fig. 14.

Figure 15 shows the annual accumulation extremes observed for each year in the eight pit studies described in this report.

FIGURE 9

PIT 6, 13 FEB 1958

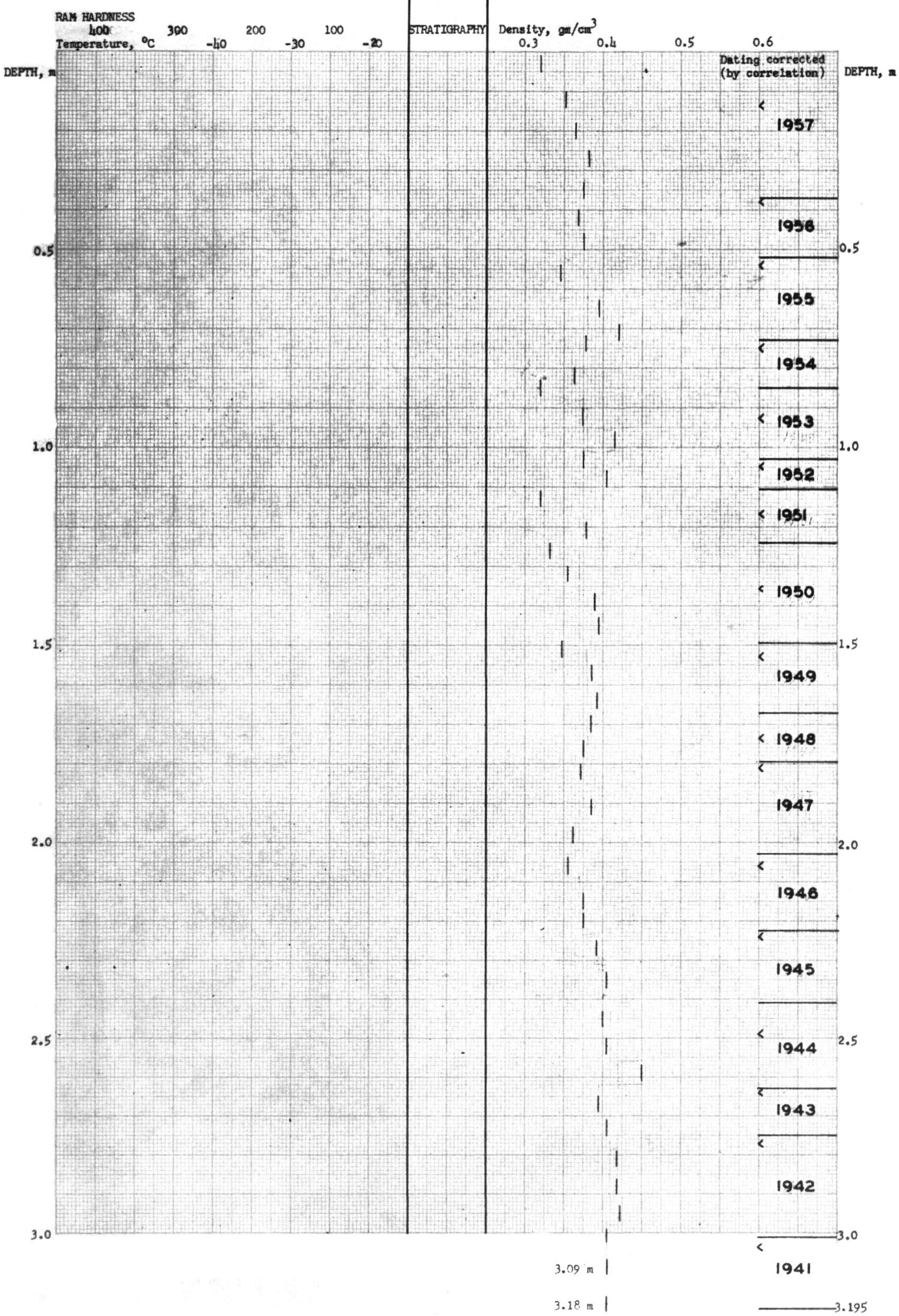


FIGURE 10

PIT 7; 16 FEB 1958

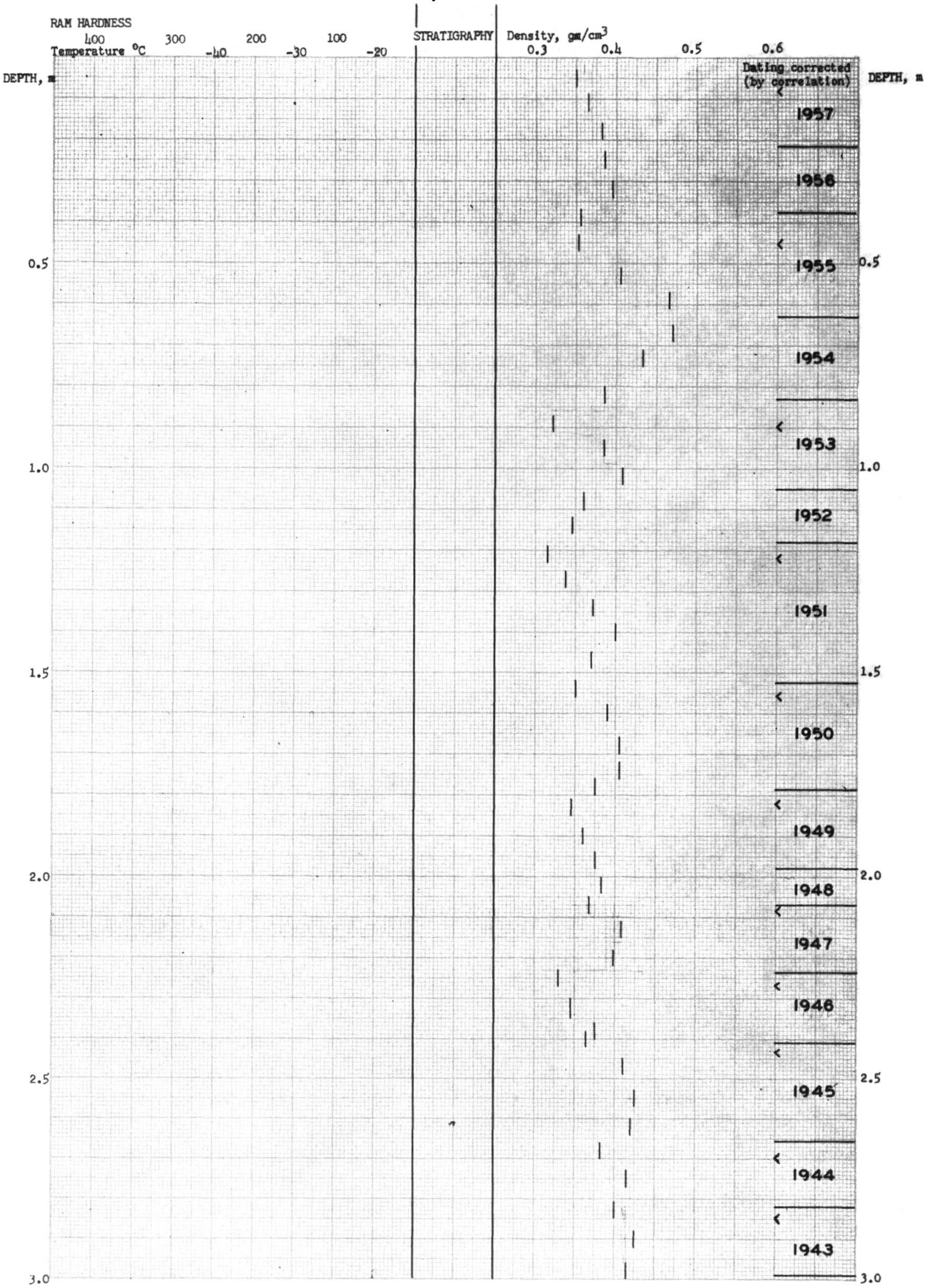


FIGURE 11

PIT 8, 27 FEB 1958

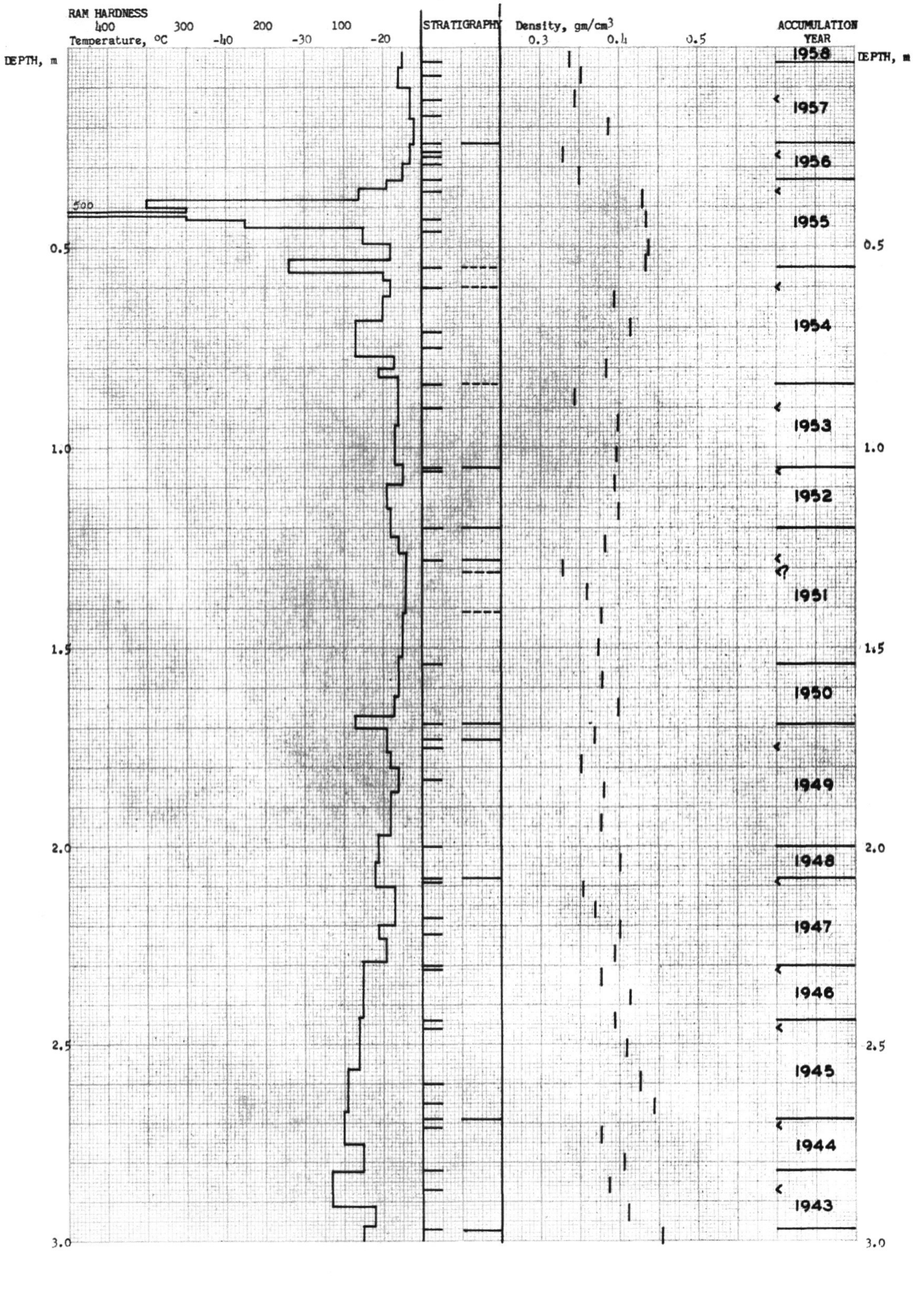


FIGURE 12

PIT 8 (CONTD)

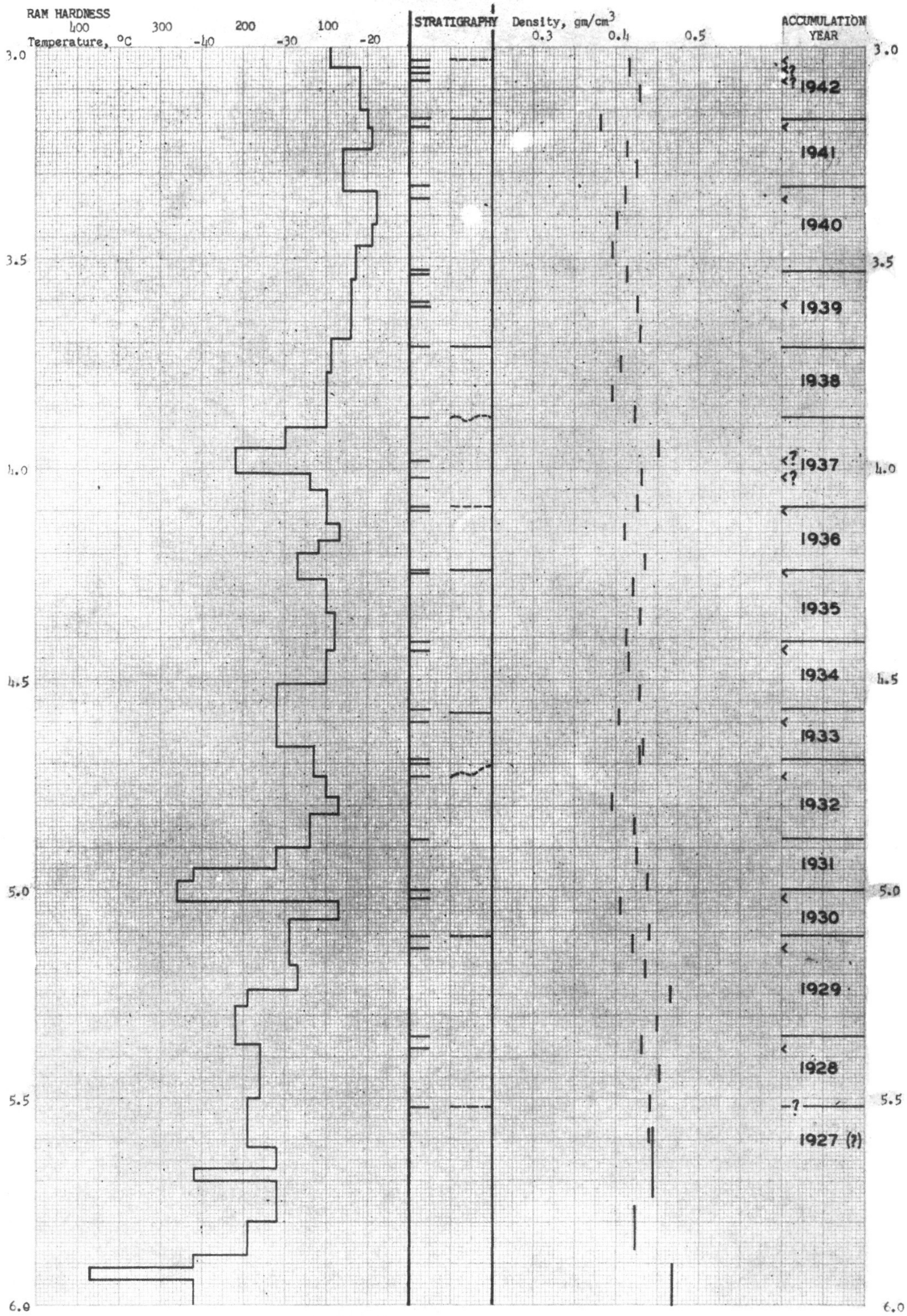


FIGURE 13
PIT 8 (CONTD)

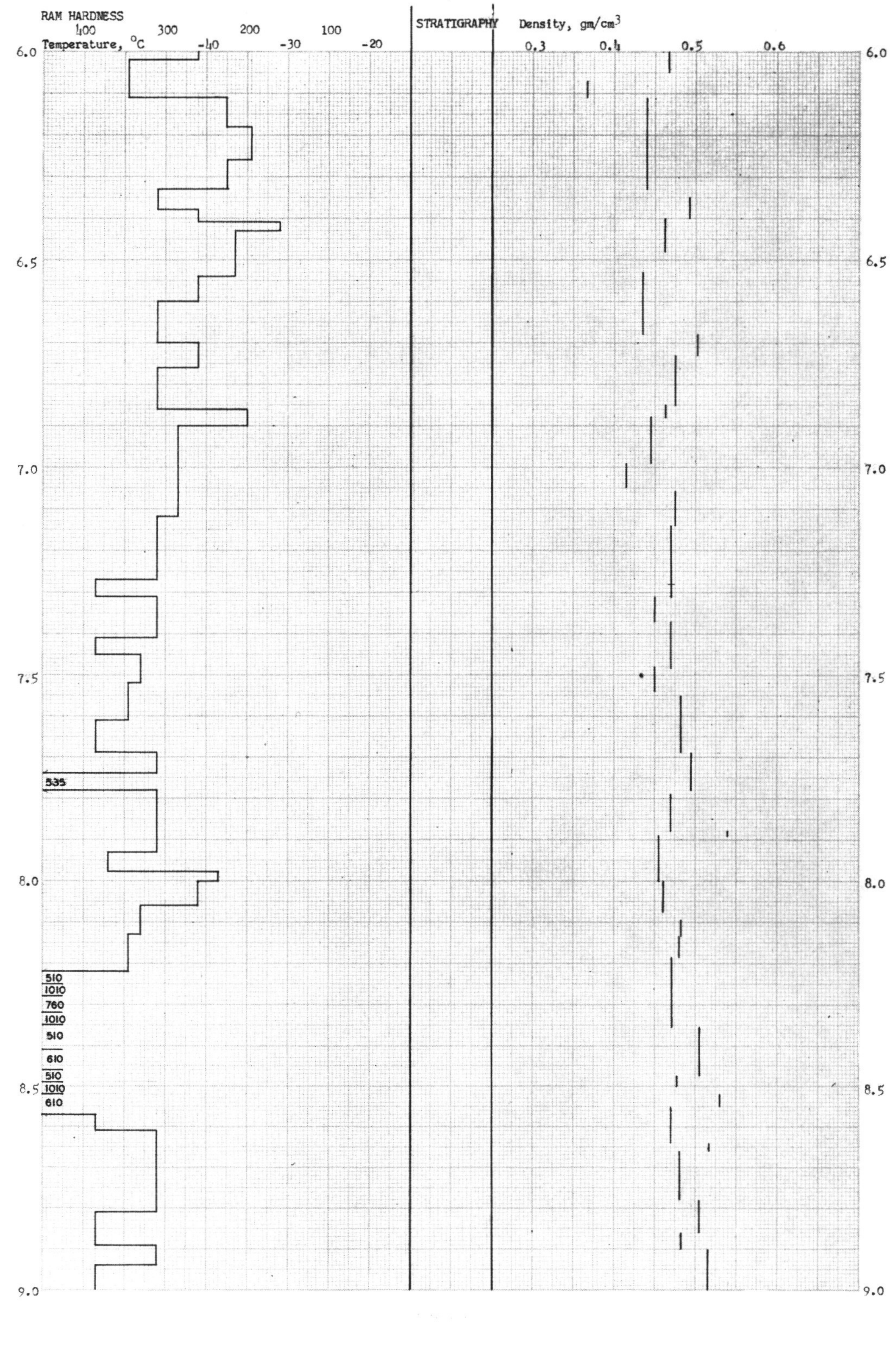


TABLE 11

Stratigraphy, Pit #8; 27 February 1958

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
0.0- 3.5	(Fall) '58	.25-0.5	Soft	There is a medium hard zone at 1.5-3 cm. of depth.
3.5- 5.0	S	.5	Very soft	Clusters; sharp edged grains.
5.0- 7.0		.25-0.5	Med. hard	This layer could have accumulated during the high speed wind periods on 12 January or 24 January.
7.0- 13.0		.5 -1.25	Soft	Clusters; irregular grains.
13.0- 17.0		.5 -1.0	Med. hard	Round grains.
17.0- 24.0	W 1957	.5 -1.0	Med. hard	Round grains.
24.0	S			Iced crust .5 mm. thick.
24.0- 26.0		.5 -1.5	Soft	Irregular grains.
26.0- 27.0		1.0 -2.5	Very soft	Sublimation crystals; clusters; large air spaces.
27.0- 29.0		.5 -1.25	Soft	Irregular grains.
29.0- 33.0	W 1956	.5 -1.25	Med. hard	Round grains; a large proportion have sharp edges.
33.0- 36.0	S	.75-1.5	Soft	Sublimation crystals (1.5 mm.) and irregular grains; clusters.
36.0- 43.0		.75-1.0	Soft	Irregular grains.
43.0- 46.0		.5	Med. hard	Round grains; compact.
46.0- 55.0	W 1955	.5 -1.0	Med. hard	Round grains.
55.0- 60.0	S	<.25-0.5	Hard	Bonded grains at the bottom; strong grain coherence near the top surface.
60.0- 71.0		.5 -1.0	Med. hard	Irregular grains; grain size increases and hardness decreases toward the top.
71.0- 75.0		.5 -0.75	Med. hard	Round grains; compact.
75.0- 84.0	W 1954	.75-1.5	Soft	Round grains.
84.0	S			Discontinuous iced crust .5 mm. thick.
84.0- 90.0		1.0 -1.5	Soft	Some sublimation crystals; clusters.
90.0-105.0	W 1953	.5 -1.25	Med. hard	There is a less compact zone at 95-100 cm.
105.0	S			Iced crust .5 mm. thick.
105.0-106.0		1.0 -2.0	Very soft	Sublimation crystals; clusters.
106.0-120.0	W 1952	.5 -1.0	Med. hard	Grain size decreases and compaction increases toward the bottom.

TABLE 11
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
120.0	S			Iced crust .5 mm. thick.
120.0-128.0		.75-2.0	Soft	Grain size increases and compaction decreases toward the bottom.
128.0				Iced crust .75 mm. thick.
128.0-154.0	W 1951	.5 -2.0	Soft	This layer is divided by two crusts.
131.0				Granular crust .75 mm. thick; below it grain size is .5-1.5 mm.
141.0				Discontinuous bonded grain layer .5 mm. thick; below it grain size is .5-1.0 mm.
154.0-169.0	W 1950	.25-1.0	Med. hard	Compact layer; distinct horizon at 154 cm.
169.0	S			Iced crust .5 mm. thick.
169.0-173.0		.5 -1.0	Med. hard	Compact.
173.0				Iced crust .5 mm. thick.
173.0-175.0		1.0 -2.5	Very soft	Sublimation crystals; loose clusters; large air spaces; some crystals are 3 mm. long.
175.0-183.0		.5 -2.0	Soft	Irregular grains; clusters.
183.0-200.0	W 1949	.5 -1.25	Med. hard	Homogeneous layer; round grains.
200.0-208.0	W 1948	.5 -1.0	Med. hard	Compact layer; distinct horizon at 200 cm.
208.0	S			Iced crust .5 mm. thick.
208.0-209.0		1.0 -2.5	Soft	Sublimation crystals; clusters.
209.0-218.0		.75-2.0	Med. hard	Irregular grains; variable hardness.
218.0-222.0		.5 -1.5	Med. hard	Compact.
222.0-230.0	W 1947	.75-2.0		Round grains.
230.0-231.0	S	1.0 -1.5	Soft	Some sublimation crystals; clusters.
231.0-244.0	W 1946	.5 -1.5	Med. hard	There is a more compact zone about the middle.
244.0-246.0	S	1.0 -2.0	Soft	Sublimation has been active; clusters.
246.0-260.0		.5 -1.25	Med. hard	This layer is soft at the top, medium hard at the bottom; proportion of large grains is high near the top.
260.0-265.0		.5 -0.75	Med. hard	Round grains; compact.

TABLE 11
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
265.0-269.0	W 1945	.5 -1.0	Hard	Round grains.
269.0	S			Iced crust .75 mm. thick.
269.0-271.0		1.0 -2.0	Soft	Sublimation crystals; clusters.
271.0-282.0	W 1944	.5 -1.25	Med. hard	Compaction increases toward the bottom; homogeneous texture.
282.0-287.0	S	.75-1.5	Soft	Some broken sublimation crystals and sharp edged grains.
287.0-297.0	W 1943	.5 -1.25	Med. hard	Round grains.
297.0	S			Iced crust .5 mm. thick.
297.0-303.0		.25-1.25	Hard	Irregularly distributed in depth, this layer has the typical appearance of wind packed snow.
303.0				Discontinuous iced crust .5 mm. thick.
303.0-305.0		.75-1.5	Med. hard	Sharp edged grains.
305.0-306.0		.75-1.5	Med. hard	Round grains.
306.0-308.0		.75-1.5	Med. hard	Irregular grains.
308.0-317.0	W 1942	.5 -1.0	Hard	Compact.
317.0	S			Iced crust .75 mm. thick.
317.0-319.0		1.0 -3.0	Very soft	Sublimation crystals; loose clusters; large air spaces.
319.0-333.0	W 1941	1.0	Hard	There is a very hard zone at 320-325 cm. of depth.
333.0-336.0	S	1.0 -3.0	Soft	Large sharp edged grains; some are irregular grains; tight clusters.
336.0-353.0	W 1940	.75-1.0	Hard	Compact.
353.0-354.0	S	1.0 -2.0	Med. hard	This layer is soft at the top.
354.0-360.0		.75-1.0	Hard	Compact.
360.0-361.0		1.0 -2.0	Soft	Clusters; irregular grains; some sublimation crystals.
361.0-371.0	W 1939	.5 -1.0	Hard	Compact.
371.0	S			Iced crust .5 mm. thick.
371.0-387.5	W 1938	.5 -1.0	Hard	Homogeneous layer.
387.5	S			Iced crust 1.25 mm. thick; discontinuous; varies in depth between 387 and 388 cm.
387.5-398.0		.25-1.0	Hard	Compact; apparently a wind compacted layer.
398.0-402.0		.75-2.0	Soft	There is a medium hard zone at 399-401 cm.; irregular grains.

TABLE 11
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
402.0-409.0	W 1937	.75-1.5	Med. hard	Variable hardness.
409.0	S			Discontinuous crust .5 mm. thick.
409.0-410.0		1.0 -2.0	Soft	Clusters; irregular grains and few sublimation crystals.
410.0-424.0	W 1936	1.0	Hard	Compaction and hardness increase with depth.
424.0	S			Granular crust .5 mm. thick.
424.0-424.5		1.0 -2.0	Soft	Some sublimation crystals; sharp edged grains; clusters.
424.5-441.0	W 1935	.5 -1.0	Hard	Homogeneous layer.
441.0-443.0	S	1.0 -2.0	Soft	Clusters; irregular grains.
443.0-457.0	W 1934	.5 -1.5	Hard	Compact.
457.0-460.0	S	1.0 -2.0	Soft	Clusters; irregular grains.
458.0				Crust .5 mm. thick; even thickness; granular.
460.0-469.0	W 1933	.5 -1.5	Hard	Compact.
469.0-470.0	S	1.0 -2.0	Soft	Some clusters; sharp edged grains.
470.0-473.0		.5 -1.5	Med. hard	Irregularly distributed in depth; it has marked undulations.
473.0				Crust .5 mm. thick; in other walls of the pit this crust divides the above layer and finally it joins the horizon at 470 cm.
473.0-488.0	W 1932	1.0 -2.0	Hard	Compaction increases toward the bottom.
488.0-500.0	W 1931	.75-1.25	Hard	The horizon at 488 cm. is distinct. The top of this layer is medium hard; less compact.
500.0-502.0	S	1.0 -1.5	Med. hard	Irregular grains; sharp edges show effects of considerable sublimation.
502.0-511.0	W 1930	.75-1.5	Hard	Compact.
511.0	S			Discontinuous crust .5 mm. thick.
511.0-514.0		1.0 -2.0	Med. hard	Compaction increased toward the bottom.
514.0-535.0	W 1929	.75	Hard	There is a very hard zone in the middle of this layer.

TABLE 11
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Relative	Remarks
535.0-538.0	S	.75-1.0	Med. hard	Irregular grains; sharp edges.
538.0-552.0	W '28	.25-1.25	Med. hard	Homogeneous layer.
552.0	S?			Distinct horizon.
Below 552.0	W '27(?)	.25-1.25	Med. hard	Homogeneous layer.

ACCUMULATION DATA

TABLE 12

Pit #6, 13 February 1958

Accumulation Year	Year No.	Top* cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm³	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	37.0	37.0	.359	13.3	13.3	13.3
1956	2		52.0	15.0	.371	5.6	18.9	9.5
1955	3		73.0	21.0	.387	8.1	27.0	9.0
1954	4		85.0	12.0	.360	4.3	31.3	7.8
1953	5		103.0	18.0	.379	6.8	38.1	7.6
1952	6		110.5	7.5	.394	3.0	41.1	6.9
1951	7		124.0	13.5	.349	4.7	45.8	6.5
1950	8		149.5	25.5	.368	9.4	55.2	6.9
1949	9		167.0	17.5	.375	6.6	61.8	6.9
1948	10		179.5	12.5	.379	4.7	66.5	6.7
1947	11		203.0	23.5	.373	8.8	75.3	6.8
1946	12		222.5	19.5	.369	7.2	82.5	6.9
1945	13		241.0	18.5	.399	7.4	89.9	6.9
1944	14		263.0	22.0	.419	9.2	99.1	7.1
1943	15		275.0	12.0	.401	4.8	103.9	6.9
1942	16		301.0	26.0	.417	10.8	114.7	7.2
1941	17		319.5	18.5	.405	7.5	122.2	7.2

*Top of layer same as bottom of preceding annual layer.

TABLE 13

Pit #7, 16 February 1958

Accumulation Year	Year No.	Top* cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm³	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1957	1	0.0	21.5	21.5	.366	7.9	7.9	7.9
1956	2		37.5	16.0	.390	6.2	14.1	7.1
1955	3		63.0	25.5	.395	10.1	24.2	8.1
1954	4		83.0	20.0	.429	8.6	32.8	8.2
1953	5		105.0	22.0	.371	8.2	41.0	8.2
1952	6		118.0	13.0	.353	4.6	45.6	7.6
1951	7		152.5	34.5	.359	12.4	58.0	8.3
1950	8		178.5	26.0	.385	10.0	68.0	8.5
1949	9		198.0	19.5	.363	7.1	75.1	8.9
1948	10		207.0	9.0	.377	3.4	78.5	7.9
1947	11		223.5	16.5	.396	6.5	85.0	7.7
1946	12		241.0	17.5	.354	6.2	91.2	7.6
1945	13		265.5	24.5	.419	10.3	101.5	7.8
1944	14		282.0	16.5	.399	6.6	108.1	7.7
1943	15		299.0	17.0	.413	7.0	115.1	7.7

*Top of layer same as bottom of preceding annual layer.

TABLE 14

Pit #8, 27 February 1958

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1958		0.0	3.5	3.5	.338		1.2	
1957	1	3.5	24.0	20.5	.362	7.4	8.6	7.4
1956	2	24.0	33.0	9.0	.340	3.1	11.7	5.9
1955	3	33.0	55.0	22.0	.435	9.6	21.3	7.1
1954	4	55.0	84.0	29.0	.398	11.5	32.8	8.2
1953	5	84.0	105.0	21.0	.381	8.0	40.8	8.2
1952	6	105.0	120.0	15.0	.397	6.0	46.8	7.8
1951	7	120.0	154.0	34.0	.364	12.4	59.2	8.4
1950	8	154.0	169.0	15.0	.390	5.9	65.1	8.1
1949	9	169.0	200.0	31.0	.371	11.5	76.6	8.5
1948	10	200.0	208.0	8.0	.402	3.2	79.8	8.0
1947	11	208.0	230.0	22.0	.381	8.4	88.2	8.0
1946	12	230.0	244.0	14.0	.396	5.5	93.7	7.8
1945	13	244.0	269.0	25.0	.423	10.6	104.3	8.0
1944	14	269.0	282.0	13.0	.393	5.1	109.4	7.8
1943	15	282.0	297.0	15.0	.400	6.0	115.4	7.7
1942	16	297.0	317.0	20.0	.433	8.7	124.1	7.8
1941	17	317.0	333.0	16.0	.405	6.5	130.6	7.7
1940	18	333.0	353.0	20.0	.402	8.0	138.6	7.7
1939	19	353.0	371.0	18.0	.421	7.6	146.2	7.7
1938	20	371.0	387.5	16.5	.407	6.7	152.9	7.6
1937	21	387.5	409.0	21.5	.435	9.4	162.3	7.7
1936	22	409.0	424.0	15.0	.422	6.3	168.6	7.7
1935	23	424.0	441.0	17.0	.420	7.1	175.7	7.6
1934	24	441.0	457.0	16.0	.421	6.7	182.4	7.6
1933	25	457.0	469.0	12.0	.421	5.1	187.5	7.5
1932	26	469.0	488.0	19.0	.408	7.8	195.3	7.5
1931	27	488.0	500.0	12.0	.431	5.2	200.5	7.4
1930	28	500.0	511.0	11.0	.423	4.7	205.2	7.3
1929	29	511.0	535.0	24.0	.443	10.6	215.8	7.4
1928	30	535.0	552.0(?)	17.0	.441	7.5	223.3	7.4

TABLE 15

Average Accumulation for Pits #6 to #8

Accum. Year	Pit 6	Pit 7	Pit 8	Annual Average	Total	Mean Accum. from Year 1
1957	13.3	7.9	7.4	9.5	9.5	9.5
1956	5.6	6.2	3.1	5.0	14.5	7.3
1955	8.1	10.1	9.6	9.3	23.8	7.9
1954	4.3	8.6	11.5	8.1	31.9	8.0
1953	6.8	8.2	8.0	7.7	39.6	7.9
1952	3.0	4.6	6.0	4.5	44.1	7.4
1951	4.7	12.4	12.4	9.8	53.9	7.7
1950	9.4	10.0	5.9	8.4	62.3	7.8
1949	6.6	7.1	11.5	8.4	70.7	7.9
1948	4.7	3.4	3.2	3.8	74.5	7.5
1947	8.8	6.5	8.4	7.9	82.4	7.5
1946	7.2	6.2	5.5	6.3	88.7	7.4
1945	7.4	10.3	10.6	9.4	98.1	7.5
1944	9.2	6.6	5.1	7.0	105.1	7.5
1943	4.8	7.0	6.0	5.9	111.0	7.4
1942	10.8		8.7	9.7	120.7	7.5
1941	7.5		6.5	7.0	127.7	7.5
1940			8.0			

FIGURE 14

ANNUAL ACCUMULATION VALUES IN WATER EQUIVALENT

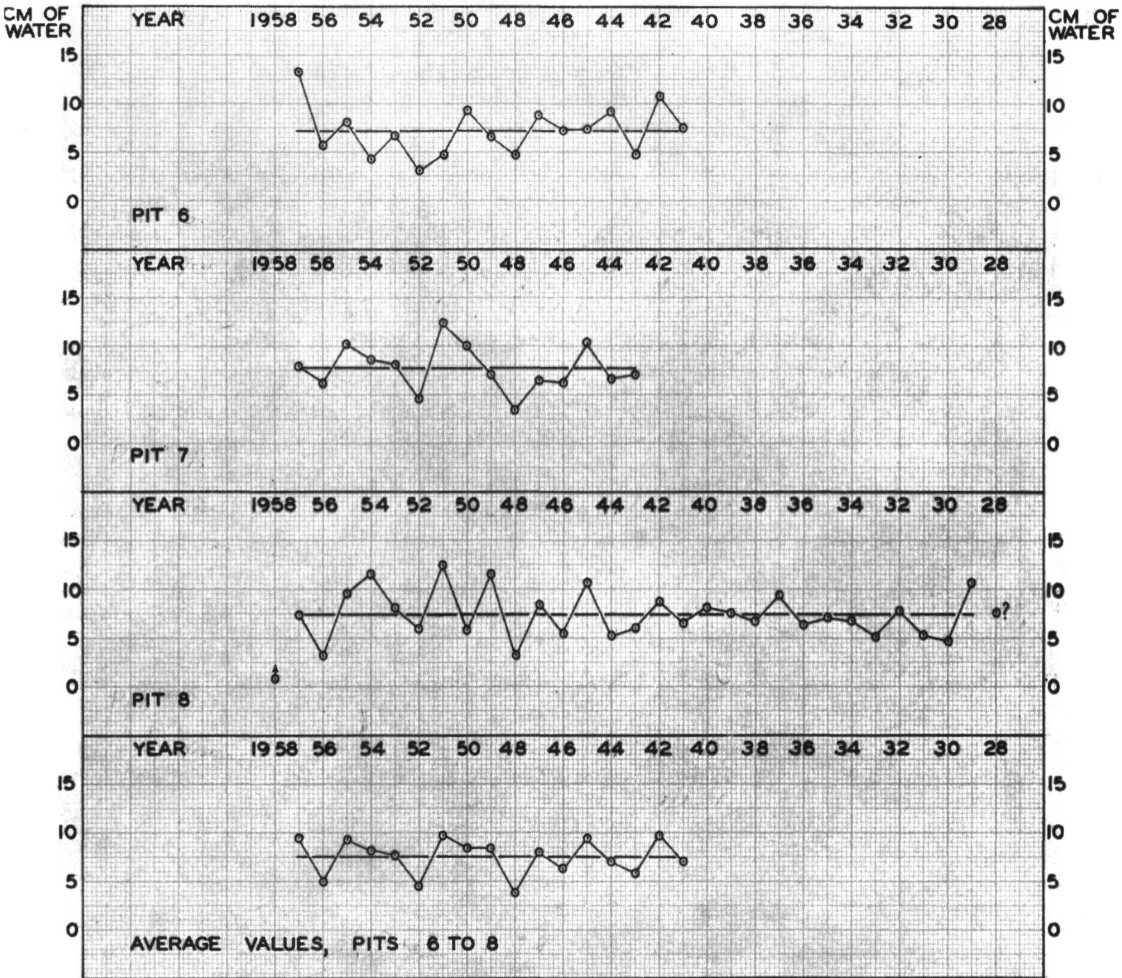
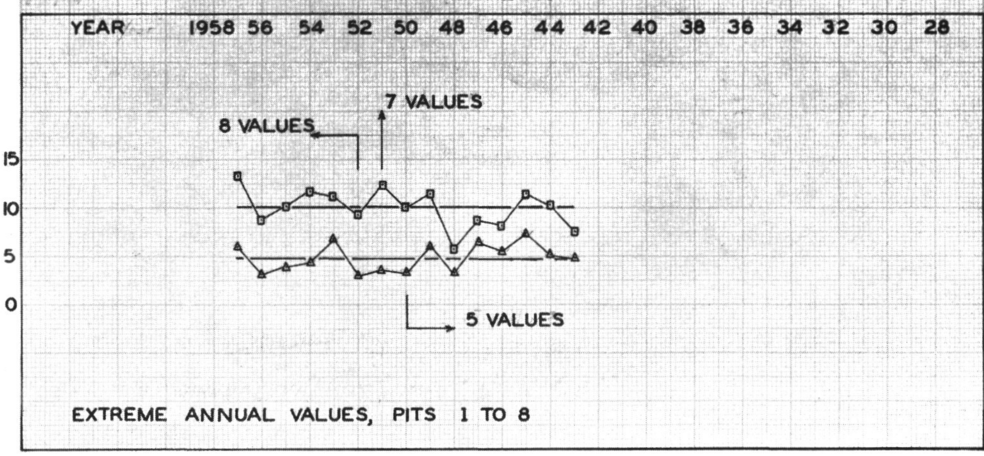


FIGURE 15



Stratigraphic Correlation between Pit #8 and the Snow Mine

Located near the entrance to the Snow Mine were two buildings and a corridor, originally built on the snow surface late in 1956. Such obstacles produced a drift several meters thick, and this load rendered the upper 5 m. of the Snow Mine unreliable for glaciological observations.

The Snow Mine consisted of an inclined shaft; it had depth markers every foot to 92 feet of total depth. These depth markers were used as the best available depth control for the observations made during 1958. They were approximately zeroed at the snow surface of early 1957. A correction of depth values in the Snow Mine should be entered for the accumulation registered since then to the time when the series of pit studies was made in February 1958, i.e., more than 15 cm. of snow. But, considering the circumstances, the data available, and above all the stratigraphic environment, to enter any such correction would be fictitious.

Therefore, in Fig. 16, the observations made in Pit #8 and in the Snow Mine are presented in respect to their uncorrected depth values. The writer suggests a correlation of the strata which may have a possible maximum error of four years.

The stratigraphic observations of Pit #8 and the Snow Mine are given in Tables 11 and 16, respectively.

It was stated before that the upper 5 m. of the Snow Mine were unsuited for glaciological observations because of overburden. The stratigraphic observations shown in Fig. 16, and the descriptions given in Table 16 (a) were made from a depth of 2.06 m. in the "vestibule," a vertical duct directly connected to the inclined shaft of the Snow Mine. This duct was located away from the entrance and the drift over it was estimated to be 1 m.

The stratigraphic observations made in the vestibule are plotted schematically along with the average density values obtained for every 0.5 m. of depth, Table 20.

The adopted correlation is taken into account from the fall horizon of the year 1942. Five pits are available with full stratigraphic control to the bottom of the annual accumulation layer of 1943, Tables 10 and 15. This gives the reader a chance to consider other possible correlations and, as shown in Table 19, allows continuing computations with different sets of accumulation values toward the surface.

FIGURE 16

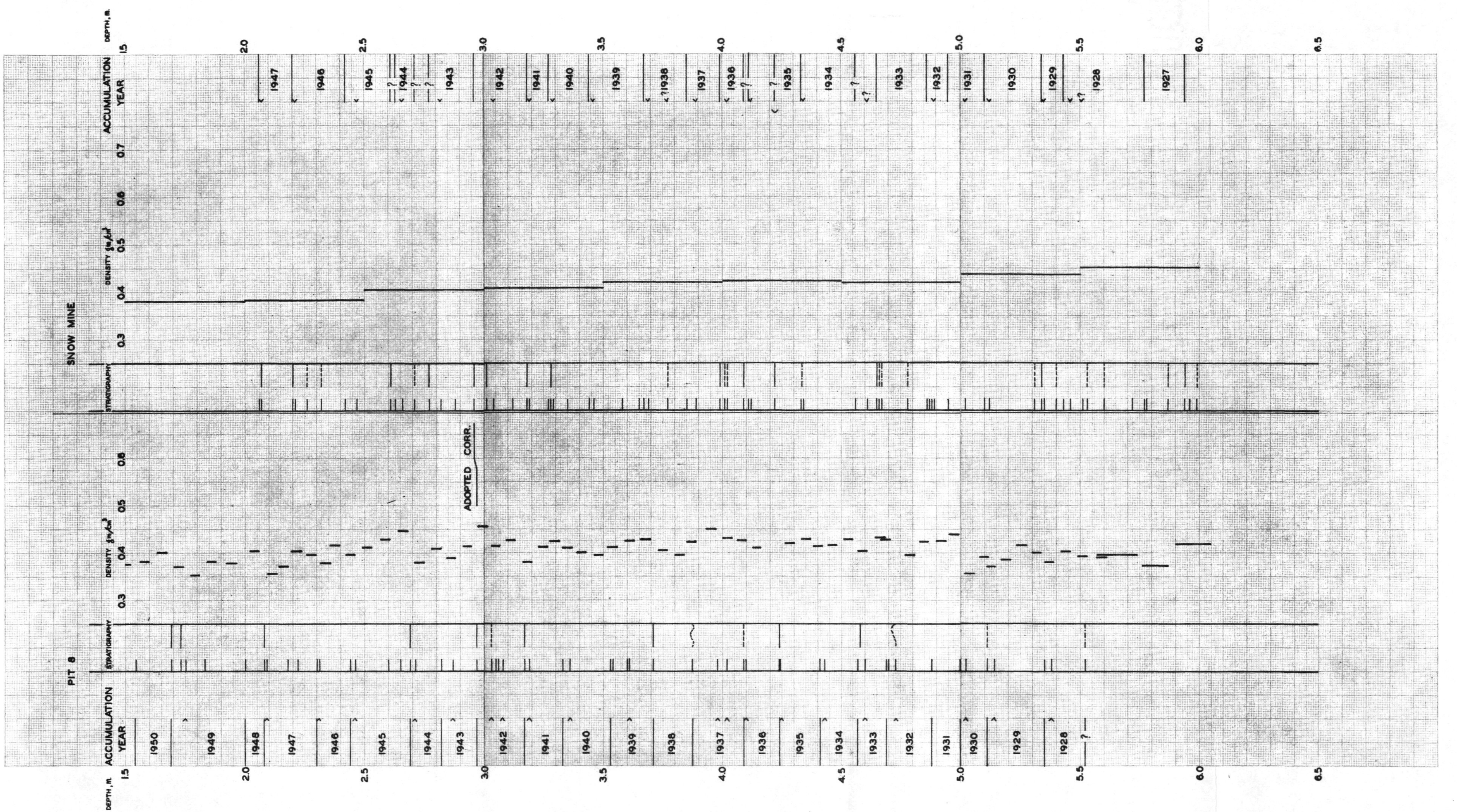

SNOW MINE
PIT 8
DEPTH, m.
ACCUMULATION YEAR
DENSITY gm/cm³
STRATIGRAPHY
ADOPTED CORR.
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
0.3
0.4
0.5
0.6
0.7
1947
1946
1945
1944
1943
1942
1941
1940
1939
1938
1937
1936
1935
1934
1933
1932
1931
1930
1929
1928
1927
1950
1949
1948

TABLE 16 (a)

Stratigraphy, SNOW MINE (Vestibule)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
Above 206	W '46			
206-207	S	1.0	3.5	Sharp edged grains and sublimation crystals; clusters.
207				Granular icy crust 1.0 mm. thick.
207-220	W 1947	.5 -1.0	4.0	Round grains.
220	S			Iced crust .5 mm. thick; grains are noticeable.
220-221		1.0	2.0	Irregular grains; there are few bonded grains, others form clusters.
221-242	W 1946	1.0 -1.5	2.5	Round grains.
226				Bonded grain layer .25 mm. thick.
232				Bonded grain layer .25 mm. thick.
242-247	S	1.0 -1.5	2.0	Sublimation crystals and sharp edged grains; clusters.
247-263	W 1945	.75-1.5	4.0	Round grains.
261	S?			Granular icy crust 1.0 mm. thick.
263-266	S	1.0 -1.5	3.0	Sublimation crystals; clusters.
266-271	W 1944	.5 -1.0	7.0	Round grains.
271	S?			Bonded grain layer 1.0 mm. thick.
271-277	S?	.75-1.25	5.5	Round grains, but there is a large proportion of irregular grains.
277	S			Iced crust 1.0 mm. thick.
277-282		1.0	3.5	Sharp edged grains; clusters. Few sublimation crystals reach a size of 1.5 mm.
282-288		.5 -1.25	4.0	Round grains.
288-296	W 1943	<.25-0.5	10.0	Round grains; top and bottom surfaces have undulations; compact.
296	S			Icy granular crust .5 mm. thick.
296-300		1.0	5.0	Small sublimation crystals and sharp edged grains.
300-301		.75-1.0	5.0	Irregular grains.
301				Granular icy crust .5 mm. thick.
301-304		1.0 -1.5	2.0	Sublimation crystals, clusters.
304-312		.75-1.0	9.0	Round grains.
312-318	W 1942	.5 -1.0	10.0	Round grains; compact.
318	S			Granular icy crust .5 mm. thick.
318-319		1.0	2.5	Sublimation crystals; clusters.
319-327	W 1941	.5 -1.0	8.0	Irregular grains.
327-329	S	1.0 -2.0	3.0	Sharp edged grains and sublimation crystals; clusters.

TABLE 16 (a)
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
328				Iced crust 1.0 mm. thick.
329-344				
329-335		.5 -1.0	5.0	Irregular grains.
335-344	W 1940	1.0 -1.5	4.0	Round grains.
344-346	S	1.0 -1.75	1.5	Sublimation crystals; clusters.
346-358		.5 -1.25	3.0	Sharp edged grains; tight clusters.
358				Distinct horizon.
358-365		.5 -1.0	5.0	Irregular grains.
365-367	W 1939	.5 -0.75	6.0	Round grains.
367-369	S	1.0	3.5	Sharp edged grains.
369-377		1.0	6.0	Irregular grains.
377				Bonded grain layer .25 mm. thick.
377-385	W 1938	.5 -1.0	9.0	Round grains.
385-389	S	.75-1.5	3.5	Irregular grains; some are bonded.
389-399	W 1937	.25-0.75	7.5	Irregular grains.
399	S			Granular crust .5 mm. thick.
399-402		1.0 -1.5	4.5	Sharp edged grains and apparently broken sublimation crystals.
401				Bonded grain layer .25 mm. thick.
402				Bonded grain layer .25 mm. thick.
402-411	W 1936	.75-1.5	6.5	Irregular grains.
409	S?			Iced crust 1.0 mm. thick.
411-412	S	1.0 -2.5	2.0	Sublimation crystals; loose clusters.
412-422	W?	.75-1.5	5.5	Irregular grains.
422	S?			Granular icy crust .75 mm. thick.
422-433	W 1935	.5 -1.0	4.5	Irregular grains.
433-434	S	1.0 -1.5	2.5	Sharp edged grains and sublimation crystals; clusters; in other walls this layer is discontinuous.
434-456	W 1934	1.0	7.0	Round grains.
456-461	S?	1.0	6.0	Irregular grains.
461-465	W?	.5 -1.0	8.0	Round grains. NOTE: In other walls of the Vestibule there was not definite evidence that the strata at depth of 434-465 cm. are accumulation from a single year.
465	S			Granular icy crust .5 mm. thick.
465-467		.75-2.0	3.0	Sharp edged grains and sublimation crystals.
466				Bonded grain layer .25 mm. thick.
467				Sharp horizon.

TABLE 16 (a)
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
				NOTE: The horizon at depth of 467 cm. was used to correlate the preceding observations with the following, made 1 m. apart on the same wall.
467-478		.5 -1.5	5.5	Irregular grains.
478				Horizon.
478-486	W 1933	.5 -1.0	7.5	Round grains.
486-489	S	1.0 -1.5	6.0	Irregular grains; in other walls this layer has the "typical" characteristics of a summer layer.
487-488		.25-1.0	9.0	Some grains are bonded.
489-495	W 1932	.5 -1.25	8.0	Irregular grains; compact.
495-502	S	.75-2.0	4.0	Irregular grains; some resemble fragments of sublimation crystals.
502-510	W 1931	.5 -1.0	9.5	Irregular grains.
510-512	S	1.0 -2.0	3.5	Sharp edged grains and interlocked sublimation crystals.
512-531		.75-1.5	6.5	Irregular grains.
531				Bonded grain layer .25 mm. thick. NOTE: The layer at depth of 531 cm. was used to correlate the preceding observations with the following, made 1 m. apart on the same wall.
531-534	W 1930	.75-1.5	6.0	Round grains.
534	S			Icy crust .5 mm. thick; grains are noticeable.
534-535		1.0 -2.0	4.0	Sharp edged grains.
535-540		.5 -1.0	8.0	Irregular grains.
540				Bonded grain layer .25 mm. thick.
540-543	W 1929	.25-1.0	10.0	Compactness and all other characteristics of a wind packed layer.
543-546	S	1.0 -2.0	3.5	Sharp edged grains.
546-551		1.0	7.0	Irregular grains.
551-572		1.0	8.0	Round grains; in other walls this layer is considerably thinner.
553				Bonded grain layer .25 mm. thick.
560				Bonded grain layer .25 mm. thick.
572-577	W 1928	<.25-1.0	40.0	Compact, discontinuous; wind packed layer.
577-578	S	1.0	6.5	Irregular grains; sharp edged grains.

TABLE 16 (a)
(Continued)

Depth cm.	Boundary of Annual Accum. Layers as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
578-594	W 1927	.5 -1.0	37.5	Irregular grains.
587				Bonded grain layer .25 mm. thick.
594	S			Granular icy crust .5 mm. thick.
594-596		.5 -1.0	25.0	Irregular grains; discontinuous wind packed layer.
596-599		.75-1.5	7.5	Irregular grains.
599				Granular icy crust .5 mm. thick.
599-603		.5 -1.0	10.0	Discontinuous; irregularly distributed.
603				Granular icy crust .5 mm. thick.
603-606		1.0 -1.5	6.5	Irregular grains. NOTE: All layers between 594 and 606 cm. are variable in thickness, have pronounced undulations in both top and bottom surfaces and dip, approximately 10° to the N.
606-619		1.0	9.5	Round grains.
619-625	W 1926	<.25-0.75	40.0	Wind packed layer.
625	?			Bonded grain layer .25 mm. thick.
625-632	S	.75-1.25	6.0	Sharp edged grains, but immediately below the crust at 625 cm. hardness is 8.0 kgm/cm^2 and grains are round.
632-645	W 1925	.75-1.0	37.5	Round grains; besides an unusually large proportion of irregular grains near the top surface, irregular grains are found through the whole layer.
645-648	S	.75-2.0	17.5	Sharp edged grains.
647				Granular icy crust .5 mm. thick.
648-658	W 1924	.5 -1.5	27.5	Round grains.
658	S			Iced crust 1.0 mm. thick.
658-659		1.0 -2.0	7.5	Sharp edged grains.
659-673	W 1923	.5 -1.0	27.5	Round grains; a large proportion of irregular grains are present at all levels; the layer is evenly distributed in depth. NOTE: The layer at 659-673 cm. was used to correlate the preceding observations with the following Table 16 (b) made in the principal shaft of the Snow Mine. The distance between stratigraphic columns is 4 m.

Snow Mine and Deep Core. 24 April - 7 November

Stratigraphic observations were made in the Snow Mine from a depth of 2.06 m. and below, as given in Table 16 (b) and illustrated in Figs. 17 to 20 where the annual accumulation layers are indicated.

To match the different stratigraphic sections under study it was necessary to move along the walls following key horizontal layers. In some instances the next stratigraphic section could be taken at a point where the key layer being followed was at the same depth, but often this was not the case. A résumé of the depth variations thus introduced is given in Table 17.

The consecutive identification of seasonal layers was possible to a depth just below 26.11 m., a layer corresponding to the winter accumulation of the year 1760, ± 13 years. The index on the accumulative margin of error is given in Table 18.

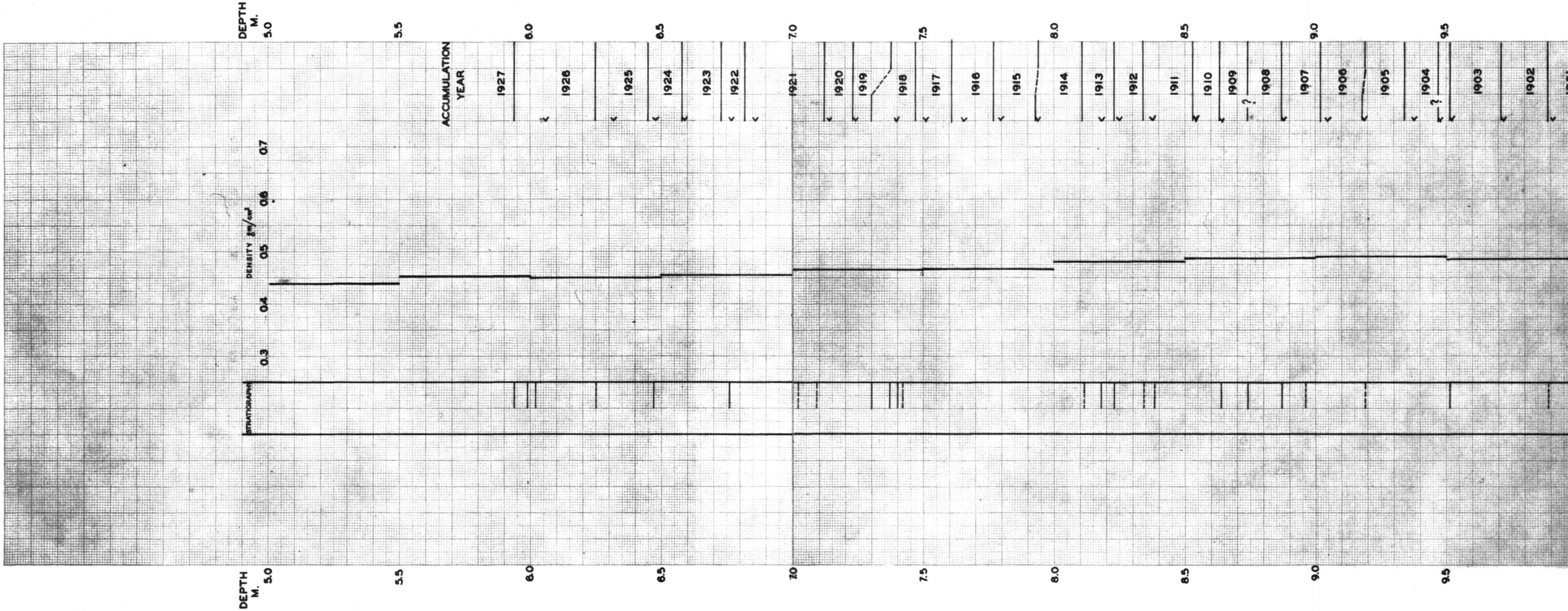
Annual water accumulation values are computed in Table 19. The variation of the individual values over the average are shown in Fig. 21; the variations of the five-year running mean are shown in Fig. 22.

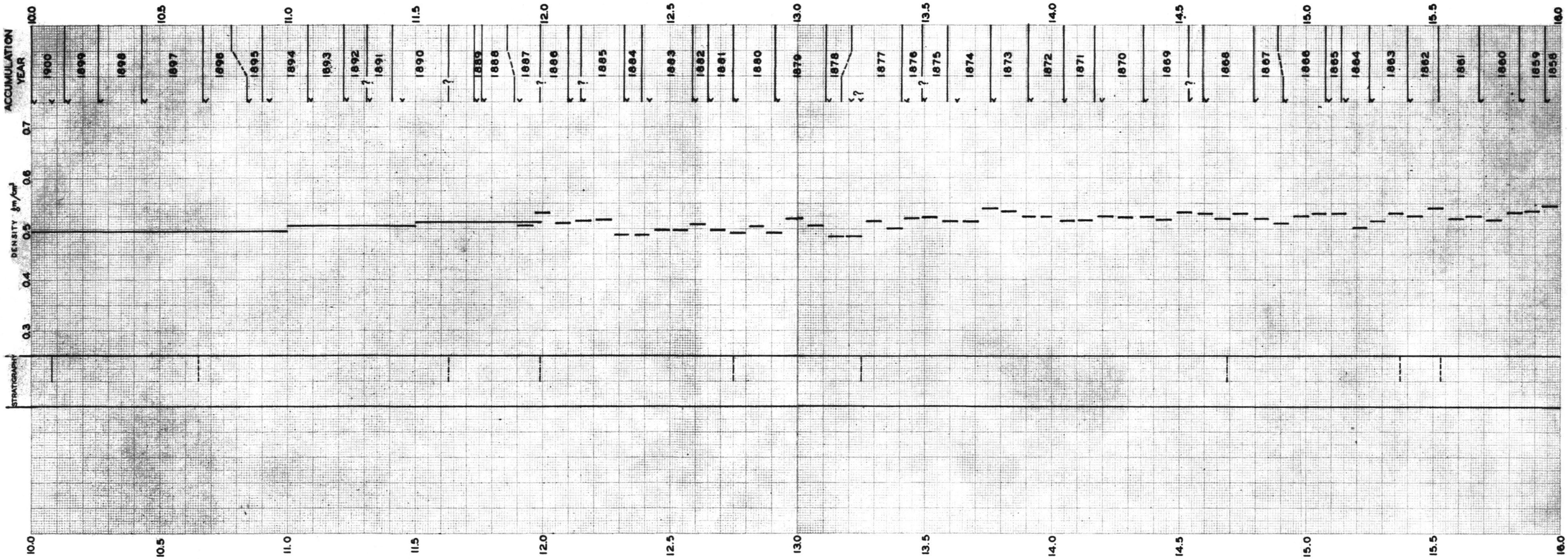
Density was measured in the Snow Mine from a depth of 11.90 m. to 27.2 m. The stratigraphy observations to that depth are plotted against the average density values computed for every 0.5 m. depth increments, Table 20. Consequently, the water accumulation values given for the years 1947 to 1888 inclusive, are computed using these average density values, Fig. 16 to 18, and Table 19.

Density was measured below a depth of 11.90 m. of cores 25 cm. long, 7.5 cm. in diameter, obtained by horizontal augering to 75 cm. in the wall. The core auger was rather large and it was necessary to hold it steadily if one was to obtain a core with an even cylindrical section; this was achieved by resting the auger in the first 50 cm. augered in the wall. The diameter of these cores varied from 74.9 mm. in the upper levels, to 75.0 mm. at the bottom of the Snow Mine. Samples were taken every 7.5 cm. of depth to allow complete coverage of the strata.

A deep core was augered from a depth of 27.20 m. to 50 m. The diameter value for each segment was consistently 76.0 mm.; the usable lengths and the density values are presented in Table 20. A depth-density profile is shown in Fig. 23.

FIGURE 17


DEPTH M.
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
ACCUMULATION YEAR
1927
1926
1925
1924
1923
1922
1921
1920
1919
1918
1917
1916
1915
1914
1913
1912
1911
1910
1909
1908
1907
1906
1905
1904
1903
1902
1901
DENSITY gm/cm³
0.3
0.4
0.5
0.6
0.7
STRATIGRAPHY


ACCUMULATION YEAR
DENSITY gm/cm³
STRATIGRAPHY
0.7
0.6
0.5
0.4
0.3
10.0
10.5
11.0
11.5
12.0
12.5
13.0
13.5
14.0
14.5
15.0
15.5
16.0
1900
1899
1898
1897
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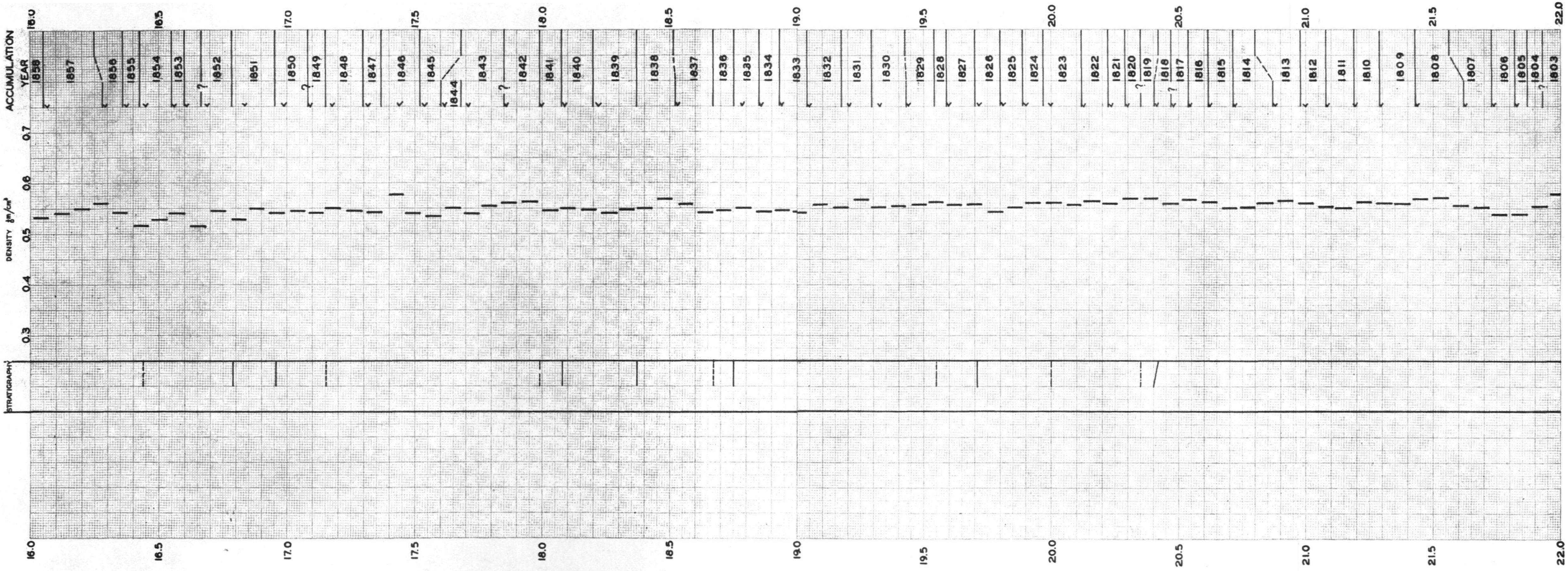
1858

FIGURE 18

FIGURE 19



ACCUMULATION YEAR
1858
1857
1856
1855
1854
1853
1852
1851
1850
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1848
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1846
1845
1844
1843
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1817
1816
1815
1814
1813
1812
1811
1810
1809
1808
1807
1806
1805
1804
1803
DENSITY gm/cm³
0.7
0.6
0.5
0.4
0.3
STRATIGRAPHY
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
20.5
21.0
21.5
22.0

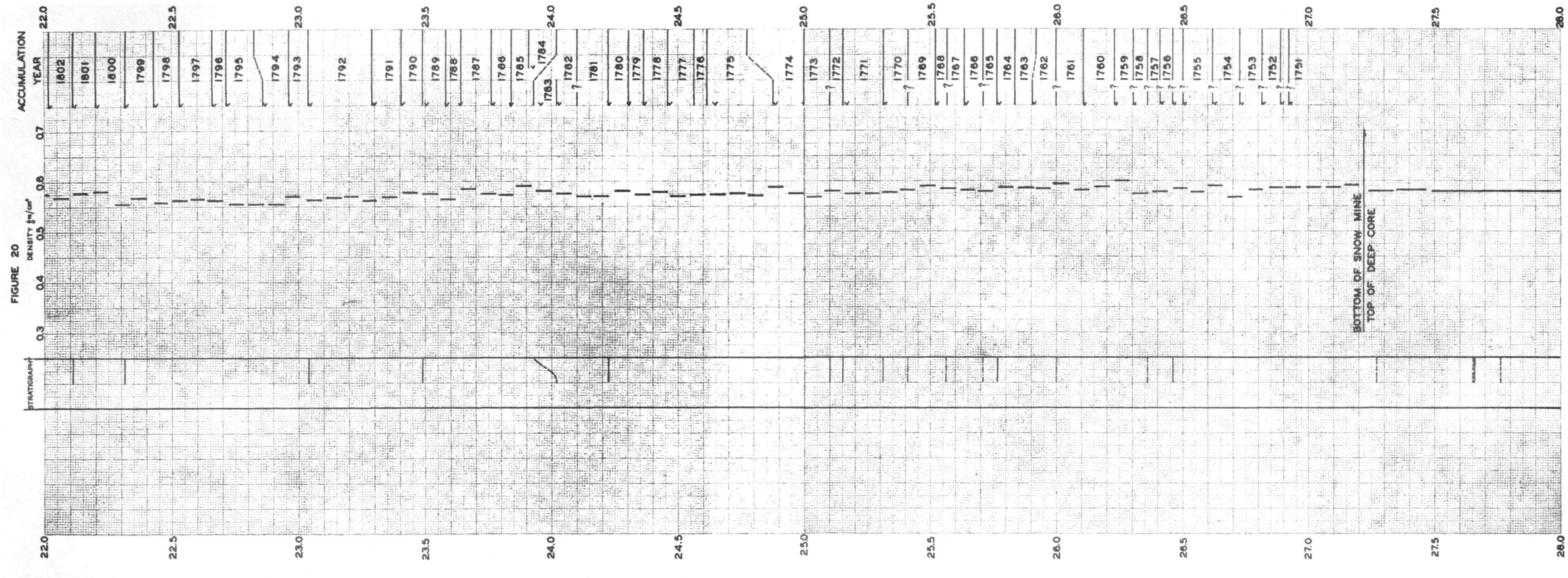

ACCUMULATION YEAR
DENSITY gm/cm³
STRATIGRAPHY
BOTTOM OF SNOW MINE
TOP OF DEEP CORE
FIGURE 20

TABLE 16 (b)

Stratigraphy, SNOW Mine (W Wall)

24 April - 7 November 1958

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
657.0-673.0	W '23	.5 -1.0	27.5	This winter layer is the same described at a depth of 659-673 in Table 16 (a).
673.0-677.0	S	.5 -1.25	17.5	
676.0				Granular icy crust 1.0 mm. thick.
677.0-682.0	W 1922	.5 -1.0	27.5	This layer shows a marked thickness increase in other sections of this wall.
682.0-686.0	S	1.0 -1.5	15.0	
686.0-702.0		.5 -0.75	27.5	
702.0				Bonded grain layer .5 mm. thick.
702.0-705.0		.5 -0.75	27.5	
705.0-709.0		1.0 -1.25	22.5	
709.0				Distinct horizon.
709.0-712.0	W 1921	.5 -1.0	35.0	Irregularly distributed in depth; variable thickness.
712.0-714.0	S	1.0	17.5	
714.0-723.0	W 1920	.5 -1.25	35.0	
723.0-724.0	S	1.0 -2.0	15.0	
724.0-737.0	W 1919	.5 -1.25	37.5	
737.0	S			Granular crust .5 mm. thick.
737.0-744.0		.75-1.5	22.5	
744.0				Granular crust .5 mm. thick.
744.0-755.0	W '18	.5 -1.25	32.5	
755.0-760.0	S	1.25	20.0	
760.0-765.0		.5 -1.0	35.0	
765.0-768.0	W '17	1.0	40.0	
768.0-769.0		1.0 -1.5	15.0	
769.0-783.0	W '16	.5 -1.0	37.5	
783.0-785.0	S	1.0 -1.5	17.5	
784.0				Iced crust 1.0 mm. thick; discontinuous.
785.0-801.0		.5 -1.5	45.0	Wind packed layer; discontinuous.
785.0-792.0		.75-1.5	40.0	
792.0-801.0	W '15	.5 -1.0	50.0	Wind packed layer; discontinuous.
797.0				Granular crust .25 mm. thick; discontinuous.
801.0-802.0	S	1.0 -1.5	17.5	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
				NOTE: The layers from 737.0 to 802.0 cm. were followed approximately 1 m. northward in the same wall where observations were continued.
730.0	S			Granular crust .5 mm. thick. This crust is found at a depth of 737.0 cm. in the preceding stratigraphic description.
730.0-736.0		.75-1.5	22.5	
736.0-740.0		.25-1.0	50.0	Wind packed layer; uneven and discontinuous.
740.0				Granular crust .5 mm. thick.
740.0-742.0		1.0	20.0	Typical layer formed below hard, wind-packed layer.
742.0				Bonded grain layer .25 mm. thick; discontinuous.
742.0-747.0	W 1918	.5 -1.0	37.5	
747.0-751.0	S	1.0 -1.5	15.0	
751.0-761.0	W 1917	.75-1.25	35.0	Compaction increases with depth.
761.0-766.0	S	.75-1.5	20.0	
766.0-777.0	W 1916	.5 -1.0	37.5	
777.0-780.0	S	1.0	20.0	
780.0-794.0	W 1915	.5 -1.0	40.0	
794.0-797.0	S	.75-1.5	17.5	
				NOTE: The layer at 794.0-797.0 cm. was followed 1.5 m. northward on the same wall where observations were continued.
797.0-812.0	W '14	.5 -1.0	32.5	
812.0	?			Granular crust .5 mm. thick.
812.0-814.0	S	1.0 -2.0	17.5	
813.0				Iced crust .75 mm. thick.
814.0-821.0		1.0 -1.5	27.5	
821.0-827.0		1.0 -1.5	30.0	
827.0-835.0	W '13	.5 -1.0	50.0	Wind-packed layer; discontinuous.
835.0-838.0	S	.75 -1.5	20.0	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm²	Remarks
793.0-794.0	S	.75-1.5	15.0	This layer is found at a depth of 794.0-797.0 cm. in the previous stratigraphic description.
794.0-811.0	W 1914	.25-1.0	37.5	
811.0				Granular crust or bonded grain layer (?) .25 mm. thick.
811.0-813.0	S	1.0 -2.0	12.5	Small, tight clusters; some bonded grains.
813.0-818.0		.25-1.0	45.0	Wind packed layer; irregularly distributed in depth and discontinuous.
818.0				Granular icy crust .5 mm. thick.
818.0-819.5		1.0 -1.75	25.0	
819.5-823.0	W 1913	1.0 -1.25	30.0	This layer is few cm. thicker in other walls.
823.0	?			Granular icy crust .5 mm. thick; discontinuous.
823.0-825.0	S	.75-2.0	15.0	
825.0-834.0	W 1912	.25-1.0	30.0	
834.0	?			Bonded grain layer .25 mm. thick.
834.0-838.0	S	.5 -2.0	20.0	
838.0				Bonded grain layer .25 mm. thick.
838.0-853.0	W 1911	.5 -1.25	35.0	
853.0-854.0	S	.75-2.0	22.5	Some bonded grains; this is layer is irregularly distributed in depth.
854.0-863.5	W 1910	.25-1.0	45.0	
863.5	S			Granular icy crust 1.0 mm. thick.
863.5-864.0		1.0 -2.0	25.0	Some bonded grains; there is no distinct boundary between this and the following layer.
864.0-874.0	W? 1909	.5 -1.0	35.0	
874.0	S?			Granular crust .5 mm. thick.
874.0-887.0	W 1908	.25-1.0	37.5	
887.0	S			Granular crust .5 mm. thick.
887.0-888.0		1.0 -2.0	20.0	Grain size and compaction change gradually to values given for the following layer.
888.0-896.0		.5 -1.25	37.5	
896.0				Bonded grain layer .25 mm. thick.
896.0-902.0	W 1907	.25-1.0	40.0	
902.0-905.0	S	.5 -2.0	27.5	
905.0-919.0	W 1906	.5 -1.25	50.0	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
919.0	?			Bonded grain layer .25 mm. thick; discontinuous.
919.0- 922.0	S	1.0 -2.0	20.0	
				NOTE: The summer layer at 919.0-922.0 cm. was used to move 2.5 m. northward on the same wall, where observations were continued.
918.0- 919.0	S	1.0 -2.0	10.0	This layer is described at a depth of 919.0-922.0 cm. in previous stratigraphic description.
919.0- 934.0	W 1905	∠.5 -1.0	35.0	
934.0- 938.0	S	.75-2.0	20.0	The upper and lower boundaries of this layer are transition zones where characteristics change gradually from layer to layer.
938.0- 947.0	W?	.5 -1.0	45.0	
947.0- 947.5	S?	.5 -1.5	25.0	
947.5- 951.5	W 1904	.5 -1.0	40.0	
951.5				Granular crust .5 mm. thick.
951.5- 952.0	S	.5 -2.0	15.0	
952.0- 971.0	W 1903	<.5 -1.25	45.0	This winter layer has the following characteristics.
952.0- 955.0		.75-1.25	20.0	
955.0- 961.0		.5 -1.25	35.0	
961.0- 967.0		<.5 -0.75	65.0	
967.0- 971.0		.5 -1.0	45.0	
971.0- 972.0	S	1.0 -2.0	15.0	
972.0- 989.0	W 1902	<.5 -1.0	50.0	
989.0				Bonded grain layer .25 mm. thick.
989.0- 990.5	S	.75-2.0	20.0	
990.5-1000.0	W 1901	.25-1.0	50.0	
1000.0-1001.0	S	1.0 -2.0	15.0	
1001.0-1007.0	W 1900	<.5 -1.0	40.0	This layer is thicker in other walls.
1007.0-1008.0	S	.75-1.75	15.0	
1008.0				Granular crust .5 mm. thick.
1008.0-1013.0		.75-1.5	30.0	Compact; irregularly distributed in depth; discontinuous.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1013.0-1014.0		.5 -1.75	25.0	
1014.0-1026.0	W 1899	.25-1.0	45.0	This layer is thicker in other walls.
1026.0-1027.0	S	.75-2.0	15.0	
1027.0-1043.0	W 1898	.5 -1.25	45.0	
1043.0-1044.0	S	.75-2.0	15.0	
1044.0-1065.0		.25-1.25	60.0	Irregularly distributed with respect to depth; discontinuous.
1065.0				Bonded grain layer .25 mm. thick.
1065.0-1066.5	W 1897	.5 -1.25	40.0	
1066.5-1067.0	S	.5 -1.5	20.0	
1067.0-1078.0	W 1896	.25-1.0	55.0	
1078.0-1079.0	S	.5 -1.75	25.0	
				NOTE: The summer layer at 1078.0-1079.0 cm. was used to moved 2.5 m. northward on the same wall where observations were continued.
1084.0-1085.0	S			Same summer layer as described at depth of 1078.0-1079.0 cm.
1085.0-1090.0	W 1895	.5 -1.0	45.0	
1090.0-1093.0	S	.5 -2.0	25.0	
1093.0-1108.0	W 1894	.25-1.0	60.0	
1108.0-1109.0	S	.5 -1.5	25.0	
1109.0-1122.0	W 1893	.5 -1.5	55.0	
1122.0-1123.0	S	.5 -1.5	25.0	
1123.0-1131.0	W 1892	.5 -1.0	70.0	
1131.0-1132.0	S?	.75-1.5	60.0	Observations in other walls did not show any other evidence in respect to the seasonal identification of this layer.
1132.0-1141.0	W 1891	.5 -1.0	70.0	
1141.0-1145.0	S	.5 -1.5	30.0	
1145.0-1163.0	W 1890	.5 -2.0	70.0	Grain size increases toward the top; 2 mm. grains are noticed at 1145.0-1146.0 cm.
1163.0	S?			Distinct horizon; discontinuous.
1163.0-1173.0	W?	.5 -1.25	80.0	
1173.0-1174.0	S	.5 -1.75	30.0	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1174.0-1176.0	W 1889	.5 -1.25	70.0	This layer is uneven in thickness; continuous.
1176.0-1177.0	S	.5 -1.75	30.0	
1177.0-1186.0	W 1888	.5 -1.25	65.0	
1186.0-1189.0	S	<.5 -1.75	35.0	
				NOTE: This summer layer was used to move 3 m. northward on the same wall.
1189.0-1191.0	S	.25-2.0	40.0	Same summer layer as described at 1186.0-1189.0 cm.; this layer is divided in three zones, equally thick.
		.5 -2.0	35.0	Top.
		.25-1.0	50.0	Middle.
		.5 -1.5	40.0	Bottom.
1191.0-1210.0	W 1887	.5 -1.5	80.0	
1199.0	S?			Distinct horizon.
1199.0-1210.0	W 1886	.5 -1.5	80.0	
1210.0-1210.5	S	.5 -1.25	35.0	
1210.5-1215.0		.25-1.0	60.0	
1215.0-1215.5	S?	.5 -1.5	40.0	
1215.5-1232.0	W 1885	.5 -1.75	80.0	
1232.0-1232.5	S	.5 -1.5	45.0	
1232.5-1238.5	W 1884	.5 -1.25	65.0	
1238.5-1239.0	S	.75-2.0	30.0	
1239.0-1241.0		.25-1.5	50.0	Wind-packed layer; irregularly distributed with respect to depth; discontinuous.
1241.0-1242.0		.5 -1.5	35.0	
1242.0-1259.0	W 1883	.5 -1.0	80.0	
1259.0-1259.5	S	.5 -1.5	35.0	
1259.5-1265.0	W 1882	.5 -1.25	75.0	
1265.0-1266.0	S	.5 -2.0	35.0	
1266.0-1275.0	W 1881	.5 -1.25	80.0	
1275.0				Discontinuous granular crust .5 mm. thick.
1275.0-1275.5	S	.5 -2.0	35.0	
1275.5-1291.5	W 1880	.5 -1.25	70.0	
1291.5-1292.0	S	.5 -2.0	35.0	
1292.0-1311.0				This layer is crossed by a "dim" horizon that dips 15^{o} to the N.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1292.0-1303.0		.5 -1.25	90.0	
1303.0-1311.0	W 1879	.5 -1.0	>100.0	
1311.0-1312.0	S	.5 -2.0	35.0	
1312.0-1321.0	W 1878	.5- 1.25	90.0 to >100.0	
1321.0-1321.5	S	.5 -2.0	40.0	NOTE: This summer layer was used to move 3 m. northward on the same wall.
1317.0-1321.0	S	.5 -2.0	35.0	This summer layer is the same as described at 1321.0-1321.5.
1321.0-1341.0	W 1877	.5 -1.25	70.0	
1325.0				Distinct horizon.
1341.0-1343.0	S	.5 -1.5	45.0	
1343.0-1349.0	W 1876	.5 -1.5	90.0	
1349.0-1350.0	S?	.5 -1.75	70.0	
1350.0-1359.0	W? 1875	.5 -1.5	90.0	
1359.0-1363.0	S	.5 -2.0	65.0	
1363.0-1376.0	W 1874	.25-1.5	100.0	
1376.0-1377.0	S	.5 -2.0	60.0	
1377.0-1378.0		.5 -2.25	>100.0	Uneven, discontinuous layer; it has all the characteristics of a wind packed layer despite the large grain size.
1378.0-1385.0		.5 -1.75	75.0	
1385.0-1390.5	W 1873	.5 -1.0	95.0	
1390.5-1391.5	S	.5 -2.25	50.0	
1391.5-1404.5	W 1872	.5 -1.5	95.0	
1404.5-1405.0	S	.5 -2.0	55.0	
1405.0-1417.0	W 1871	.5 -1.5	90.0	
1417.0-1420.0	S	.5 -2.0	50.0	
1420.0-1436.0	W 1870	.5 -1.75	100.0	
1436.0-1436.5	S	.5 -2.0	50.0	
1436.5-1453.5	W 1869	.5 -1.5	100.0	
1453.5-1454.0	S?	.5 -1.5	80.0	
1454.0-1459.5	W?	.5 -1.25	>100.0	Winter layer or wind-packed layer accumulated in late summer.
1459.5-1461.0	S	.5 -1.5	55.0	
1461.0-1479.5	W 1868	.5 -1.5	100.0	
1469.0				Distinct horizon; discontinuous.
1479.5-1480.0	S	.5 -1.75	85.0	
1480.0-1489.0	W 1867	.5 -1.5	95.0	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1489.0-1490.0	S	.5 -2.0	60.0	
				NOTE: This summer layer was used to move 3.5 m. northward on the same wall.
1491.0-1491.5	S	.5 -1.5	45.0	Same layer described at 1489.0-1490.0 cm.
1491.5-1508.0	W 1866	.5 -1.5	95.0	
1508.0-1509.0	S	.5 -1.75	50.0	
1509.0-1514.0	W 1865	.5 -1.75	100.0	
1514.0-1515.5	S	.5 -1.75	35.0	
1515.5-1525.0	W 1864	.5 -1.5	70.0	
1525.0-1526.0	S	.5 -1.5	60.0	
1526.0-1537.0		.5 -1.0	90.0	
1537.0				Bonded grain layer .5 mm. thick.
1537.0-1540.0	W 1863	.5 -1.0	>100.0	
1540.0-1541.0	S	.5 -2.0	60.0	
1541.0-1552.5	W 1862	.5 -1.5	90.0	Compaction increases and grain size decreases toward the bottom.
1552.5	S			Bonded grain layer .5 mm. thick; in other walls, it is similar to the summer layer at 1540.0-1541.0 cm.
1552.5-1568.5	W 1861	.5 -1.25	100.0	
1568.5-1569.0	S	.5 -2.0	50.0	
1569.0-1584.0	W 1860	.5 -1.75	95.0	
1584.0-1585.0	S	.5 -1.5	75.0	
1585.0-1594.0	W 1859	.5 -1.5	>100.0	
1594.0-1595.0	S	.5 -2.0	60.0	
1595.0-1605.0	W 1858	.5 -1.5	>100.0	
1605.0-1607.0	S	.5 -2.0	65.0	
1607.0-1625.0	W 1857	.5 -1.5	>100.0	
1625.0-1626.0	S	.5 -2.0	80.0	
				NOTE: This layer was used as a guide to move 5 m. northward on the same wall.
1628.0-1629.0	S	.5 -2.0	75.0	Same summer layer as described at 1625.0-1626.0 cm.
1629.0-1636.0	W 1856	.5 -1.5	>100.0	
1636.0-1637.5	S	.5 -2.0	80.0	
1637.5-1642.5	W 1855	.5 -1.5	>100.0	
1642.5-1645.0	S	.5 -2.0	70.0	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1643.5				Discontinuous horizon.
1645.0-1655.0	W 1854	.5 -1.5	>100.0	
1655.0-1655.5	S	.5 -2.0	70.0	
1655.5-1660.0	W 1853	.5 -1.5	>100.0	
1660.0-1660.5	S	.5 -2.0	75.0	
1660.5-1666.5	W?	.5 -1.75	>100.0	
1666.5-1669.0	S?	.5 -2.0	80.0	Boundaries are poor.
1669.0-1678.5	W 1852	.5 -1.5	>100.0	
1678.5	S			Icy crust .5 mm. thick; granular boundaries are hard to observe.
1678.5-1683.5		.5 -2.0	65.0	
1683.5-1695.5	W 1851	.5 -1.5	>100.0	
1695.5	S			Icy crust .5 mm. thick; very translucent.
1695.5-1699.0		.5 -2.0	75.0	Poor boundaries.
1696.0-1698.5		.5 -1.5	>100.0	Very hard, very compact; uneven and discontinuous.
1699.0-1708.0	W 1850	.5 -1.5	>100.0	
				NOTE: The hardness of winter layers is greater than 100 kg. sq. cm. However, a difference is observed at 17 m. of depth the tip of the gauge penetrates approximately 8 mm., while at 27 m. it only penetrates 4-6 mm. Hardness values for winter layers are not indicated from here on.
1708.0-1708.5	S?	.5 -2.0	80.0	
1708.5-1715.0	W 1849	.5 -1.75		
1715.0	S			Well cemented bonded grain layer .5 mm. thick.
1715.0-1717.5		.5 -2.0	75.0	
1717.5-1729.5	W 1848	.5 -1.75		
1729.5-1731.0	S	.5 -2.0	80.0	
1731.0-1736.5	W 1847	.5 -1.5		
1736.5-1738.5	S	.5 -2.0	85.0	
1738.5-1742.5		.5 -1.75	>100.0	Extremely hard; irregularly distributed in depth; discontinuous.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1742.5-1744.0		.5 -2.0	80.0	
1744.0-1752.0	W 1846	.5 -1.5		
1752.0-1754.0	S	.5 -2.0	80.0	
1754.0-1768.0	W 1845	.5 -1.75		
1768.0-1770.0	S	.5 -2.0	75.0	NOTE: This summer layer was used as a guide to move 3 m. northward on the same wall.
1760.0-1761.5	S	.5 -2.0	85.0	Same as layer 1768.0-1770.0 cm.
1761.5-1768.0	W 1844	.5 -1.75		
1768.0-1768.5	S	.5 -2.0	90.0	
1768.5-1770.0		.5 -1.75	>100.0	Similar to the wind packed layer at 1738.5-1742.5 cm.
1770.0-1770.5		.5 -2.0	85.0	
1770.5-1785.0	W 1843	.5 -1.75		
1785.0-1785.5	S?	.5 -2.0	95.0	
1785.5-1799.0	W? 1842	.5 -2.0		
1799.0				Bonded grain layer .5 mm. thick; discontinuous.
1799.0-1800.0	S	.5 -2.0	80.0	
1800.0-1807.5	W 1841	.5 -2.0		
1807.5	S			Icy crust .5 mm. thick.
1807.5-1808.5		.5 -2.0	75.0	
1808.5-1819.5	W 1840	.5 -1.75		
1819.5-1821.5	S	.5 -2.0	80.0	
1821.5-1837.0	W 1839	.5 -2.0		
1837.0	S			Icy crust .5 mm. thick; in other walls it divides in two crusts enclosing a summer layer.
1837.0-1851.5	W 1838	.5 -2.0		
1851.5-1853.0	S	.5 -2.0	85.0	NOTE: This summer layer was used as a guide to move 2.5 m. northward on the same wall where studies were continued.
1852.0-1853.0	S	.5 -2.0	90.0	Same layer as described at 1851.5-1853.0 cm.
1853.0-1867.0	W 1837	.5 -1.75		
1867.0	S			Granular crust .5 mm. thick; discontinuous; it is the bottom of a summer layer in other walls.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
1867.0-1875.0	W 1836	.5 -1.75		
1875.0				Granular crust .5 mm. thick.
1875.0-1875.5	S	.5 -2.0	80.0	
1875.5-1878.0		.5 -2.0	>100.0	Discontinuous.
1878.0-1878.5		.5 -2.0	85.0	
1878.5-1885.0	W 1835			
1885.0-1886.0	S	.5 -2.0	95.0	
1886.0-1893.0	W 1834	.5 -1.75		
1893.0-1893.5	S	.5 -2.0	80.0	
1893.5-1904.0	W 1833	.5 -1.75		
1904.0-1904.5	S	.5 -2.0	85.0	
1904.5-1917.5	W 1832	.5 -2.0		
1917.5-1918.0	S	.5 -2.0	95.0	
1918.0-1920.0		.5 -2.0	>100.0	Discontinuous.
1920.0-1920.5		.5 -2.0	90.0	
1920.5-1929.5	W 1831	.5 -1.75		
1929.5-1932.5	S	.5 -2.0	85.0	
1932.5-1942.5	W 1830	.5 -1.75		
1942.5-1943.0	S	.5 -2.0	90.0	NOTE: This summer layer was used as a guide to move 2.5 m. northward on the same wall.
1943.0-1944.0	S	.5 -2.0	95.0	Same layer as described at 1942.5-1943.0 cm.
1944.0-1954.5	W 1829	.5 -2.0		
1954.5	S			Distinct horizon; this horizon is correlated to a summer layer in other sections of the wall.
1954.5-1959.0	W 1828	.5 -1.75		
1959.0-1961.0	S	.5 -2.0	90.0	
1961.0-1970.5	W 1827	.5 -2.0		
1970.5	S			Icy crust .5 mm. thick.
1970.5-1972.0		.5 -2.0	85.0	
1972.0-1980.0	W 1826	.5 -2.0		
1980.0-1981.0	S	.5 -2.0	80.0	
1981.0-1989.0	W 1825	.5 -2.0		
1989.0-1990.0	S	.5 -2.0	95.0	
1990.0-1997.0	W 1824	.5 -1.75		
1997.0-1998.0	S	.5 -2.0	90.0	
1998.0-2000.0		.5 -2.0	100.0	
2000.0				Icy crust .5 mm. thick; discontinuous.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
2000.0-2012.0	W 1823	.5 -2.0		
2012.0-2012.5	S	.5 -2.0	100.0	
2012.5-2022.5	W 1822	.5 -2.0		
2022.5-2023.5	S	.5 -2.0	95.0	
2023.5-2029.0	W 1821	.5 -2.0		
2029.0-2029.5	S	.5 -2.0	100.0	
2029.5-2035.0	W 1820	.5 -2.0		
2035.0	S?			Distinct horizon.
2035.0-2042.0	W? 1819	.5 -2.0		
2042.0	S			Granular iced crust .5 mm. thick.
2042.0-2043.0		.5 -2.0	85.0	
				NOTE: The iced crust at 2042.0 cm. was used to move 1 m. northward on the same wall.
2040.5	S			Same layer as described at 2042.0 cm.; this layer .5 mm. thick.
2040.5-2041.5		.5 -2.0	85.0	Same layer as described at 2042.0-2043.0 cm.
2041.5-2047.0	W 1818	.5 -2.0		
2047.0-2048.0	S?	.5 -2.0		
2048.0-2054.0	W 1817	.5 -2.0		
2054.0-2054.5	S	.5 -2.0		
2054.5-2061.5	W 1816	.5 -2.0		
				NOTE: At a depth of 20 m. and below, grain size range is uniform in all layers; however, a greater proportion of large grains is observed in summer layers and a greater proportion of small grains is observed in winter layers. The grain size range of .5-2.0 mm. is found consistently in the strata to the bottom of the Snow Mine.
2061.5-2062.0	S			
2062.0-2071.5	W 1815			
2071.5-2072.0	S		90.0	
2072.0-2080.0	W 1814			
2080.0-2080.5	S		100.0	

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
2087.0-2088.0	S		95.0	NOTE: This summer layer was used as a guide to move 2 m. northward on the same wall. Same layer as described at 2080.0-2080.5 cm.
2088.0-2098.0	W 1813			
2098.0-2100.0	S		>100.0	
2100.0-2108.0	W 1812			
2108.0-2108.5	S		100.0	
2108.5-2119.0	W 1811			
2119.0-2119.5	S		100.0	
2119.5-2129.0	W 1810			
2129.0-2129.5	S		90.0	
2129.5-2143.5	W 1809			
2143.5-2144.0	S		85.0	
2144.0-2156.5	W 1808			
2156.5-2157.0	S		>100.0	
2162.0-2162.5	S		100.0	NOTE: This summer layer was used as a guide to move 2 m. northward on the same wall. Same layer as described at 2156.5-2157.0 cm.
2162.5-2173.0	W 1807			
2173.0-2174.0	S		>100.0	
2174.0-2182.0	W 1806			
2182.0-2183.0	S		90.0	
2183.0-2187.0	W 1805			
2187.0	S			Distinct horizon; it is the upper boundary of a summer layer in other wall.
2187.0-2193.0	W 1804			
2193.0	S?			Distinct horizon; it is the upper boundary of a layer in other sections of the wall.
2193.0-2201.5	W? 1803			
2201.5-2202.0	S		90.0	
2202.0-2211.5	W 1802			
2211.5	S			Icy crust .5 mm. thick.
2211.5-2212.0			95.0	
2212.0-2220.0	W 1801			
2220.0-2220.5	S		>100.0	Summer layer indicated as .5 cm. thick are actually 2-3 mm. thick.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
2220.5-2231.5	W 1800			
2231.5	S			Granular icy crust .5 mm. thick; discontinuous.
2231.5-2232.0			>100.0	
2232.0-2243.0	W 1799			
2243.0-2244.0	S		>100.0	
2244.0-2253.0	W 1798			
2253.0-2253.5	S		>100.0	
2253.5-2266.0	W 1797			
2266.0-2267.0	S		>100.0	
2267.0-2271.5	W 1796			
2271.5-2272.0	S		>100.0	In other walls this layer extends between 2270.0 and 2275.0 cm.
2272.0-2282.5	W 1795			
2282.5-2283.0	S		>100.0	NOTE: This layer was used to move 3 m. northward on the same wall.
2286.0-2287.0	S		>100.0	Same layer as described at 2282.5-2283.0 cm.
2287.0-2296.5	W 1794			
2296.5-2297.0	S		>100.0	
2297.0-2304.0	W 1793			
2304.0	S			Granular icy crust .5 mm. thick.
2304.0-2305.0			>100.0	
2305.0-2329.0	W 1792			
2329.0-2330.0	S			
2330.0-2340.5	W 1791			
2340.5-2341.0	S			
2341.0-2349.0	W 1790			
2349.0	S			Icy crust .5 mm. thick.
2349.0-2350.5				
2350.5-2358.0	W 1789			
2358.0-2358.5	S			
2358.5-2364.0	W 1788			
2364.0	S			2 mm. thick layer.
2364.0-2376.0	W 1787			
2376.0-2377.0	S			
2377.0-2384.0	W 1786			
2384.0	S			3 mm. thick layer.
2384.0-2391.0	W 1785			

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
2391.0-2393.0	S			
2393.0-2402.0	W 1784			
2402.0	S			Icy crust .5 mm. thick; discontinuous.
2402.0-2402.5				
2407.0-2407.5				
				NOTE: This layer was used as a guide to move 2 m. northward on the same wall.
2393.0-2396.0	S			The upper and lower boundaries of this layer correlate with the horizons noted before at 2402.0 and 2407.5 cm., respectively.
2396.0-2402.0	W 1783			
2402.0-2403.0	S			
2403.0-2410.0	W 1782			
2410.0	S?			Bonded grain layer 2 mm. thick; discontinuous.
2410.0-2422.5	W 1781			
2422.5	S			Icy crust .5 mm. thick.
2422.5-2423.0				
2423.0-2430.5	W 1780			
2430.5-2431.0	S			
2431.0-2436.5	W 1779			
2436.5-2437.0	S			
2437.0-2446.0	W 1778			
2446.0-2447.0	S			
2447.0-2456.5	W 1777			This layer is thicker in other sections of the wall.
2456.5	S			Similar to the layer at 2410 cm.
2456.5-2461.5	W 1776			
2461.5	S			Icy crust .5 mm. thick; discontinuous.
2461.5-2464.5				
2464.5-2465.0				
2465.0-2477.5	W 1775			
2477.5-2478.5	S			
				NOTE: This layer was used as a guide to move 2 m. northward on same wall.

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm²	Remarks
2488.0-2489.0	S			Same layer as described at 2477.5-2478.5 cm.
2489.0-2499.8	W 1774			
2499.8-2500.1	S			
2500.1-2510.0	W 1773			
2510.0	S?			Icy crust .5 mm. thick.
2510.0-2515.5	W 1772			
2215.5	S			Icy crust .5 mm. thick; discontinuous.
2515.5-2517.0				
2517.0-2531.5	W 1771			
2531.5	S			Icy crust .5 mm. thick; discontinuous.
2531.5-2532.0				
2532.0-2541.0	W 1770			
2541.0	S?			Distinct horizon.
2541.0-2552.0	W 1769			
2552.0-2552.5	S			
2552.5-2556.5	W? 1768			
2556.5	S?			Distinct horizon.
2556.5-2563.5	W 1767			
2563.5-2564.0	S			
2564.0-2571.0	W 1766			
2571.0	S?			Distinct horizon.
2571.0-2576.5	W 1765			
2576.5	S			Icy crust .5 mm. thick.
2576.5-2577.0				
2577.0-2583.5	W 1764			
2583.5	S			Bonded grain layer 2 mm. thick.
2583.5-2592.0	W 1763			
2592.0-2592.5	S			
				NOTE: This layer was used to move 1.5 m. northward on the same wall.
2590.5-2591.0	S			Same layer as described at 2592.0-2592.5 cm.
2591.0-2600.0	W 1762			
2600.0	S?			Distinct horizon.
2600.0-2610.5	W 1761			
2610.5-2611.0	S			

TABLE 16 (b)
(Continued)

Depth cm.	Boundary of Annual Accum. Layer as Interpreted	Grain Size mm.	Hardness Kgm/cm^2	Remarks
				NOTE: Below the horizon at 2611.0 cm. the firn is completely homogeneous to the naked eye. The following observations and interpretations are tentatively given.
2623.0-2623.5	S?			
	W '59			
2630.5-2631.0	S?			
	W '58			
2636.0	S?			Distinct horizon.
	W '57			
2641.0-2641.5	S?			
	W '56			
2646.0	S?			Granular icy crust .5 mm. thick.
	W?			
2650.5-2651.0	S?			
	W '55			
2662.0-2663.0	S?			
	W '54			
2672.5-2673.0	S?			
	W '53			
2681.5-2682.0	S?			
	W '52			
2689.0-2690.0	S?			
or				
2692.0-2692.5	S?			
	W '51			

TABLE 17

Difference in Depth Introduced by Correlation of Two Stratigraphic Sections

Depth of Key Horizon Used in Correlation, cm. From	To	Difference Introduced in cm.	Translation on the Wall, m.
647	647	0.0	1.0
531	531	0.0	1.0
673	673	0.0	4.0
737	730	7.0 overlap	3.0
794	793	1.0 overlap	1.5
919	918	1.0 overlap	2.5
1078	1084	6.0 gap	2.5
1186	1189	3.0 gap	3.0
1321	1317	4.0 overlap	3.0
1489	1491	2.0 gap	3.5
1625	1628	3.0 gap	5.0
1768	1760	8.0 overlap	3.0
1851.5	1852	0.5 gap	2.5
1942.5	1943	0.5 gap	2.5
2042	2040.5	1.5 overlap	1.0
2080	2087	7.0 gap	2.0
2156.5	2162	5.5 gap	2.0
2282.5	2286	3.5 gap	3.0
2402	2393	9.0 overlap	2.0
2477.5	2488	0.5 gap	2.0
2592	2590.5	1.5 overlap	1.5

TABLE 18

SNOW MINE: Cumulative Error on the Identification of Annual Accumulation Layers

(Strata at a depth of 206.0 to 312.0 cm. are not considered in the annual count back)

Layer(s) and Corresponding Year(s) Where Seasonal Identification Is Doubtful		Error Introduced (Cumulative) Years	Margin of Error Years (±)
Depth, cm.	Year		
Correlation: Pit #8 and SM	1940-1944	4*	2
412.0- 422.0	1935	5	
456.0- 465.0	1934	6	3
864.0- 874.0	1908-1909	7	
938.0- 947.5	1904	8	4
1131.0-1132.0	1891-1892	9	
1163.0-1176.0	1890	10	5
1199.0	1886-1887	11	
1215.0-1216.5	1885	12	6
1349.0-1359.0	1875-1876	13	
1453.5-1459.5	1869	14	7
1660.5-1669.0	1852	15	
1708.0-1708.5	1849-1850	16	8
1785.0-1799.0	1842-1843	17	
2035.0-2042.0	1819-1820	18	9
2047.0-2048.0	1817-1818	19	
2193.0-2201.5	1803-1804	20	10
2410.0	1781-1782	21	
2510.0	1772-1773	22	11
2541.0	1769-1770	23	
2552.5-2556.5	1767-1768	24	12
2571.0	1765-1766	25	
2600.0	1761-1762	26	13

*Estimated

FIGURE 21
ANNUAL ACCUMULATION VALUES IN WATER EQUIVALENT (SNOW MINE)

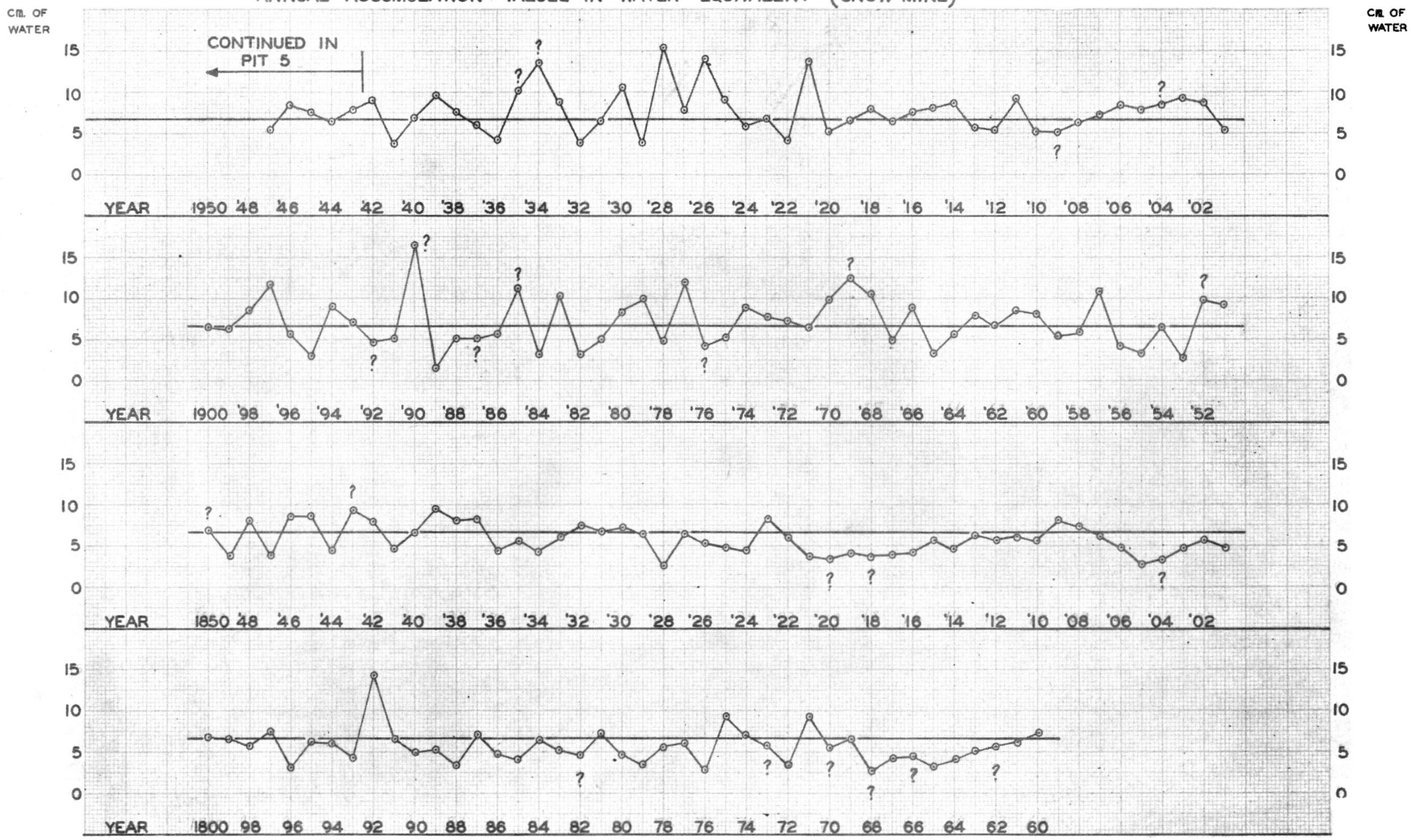
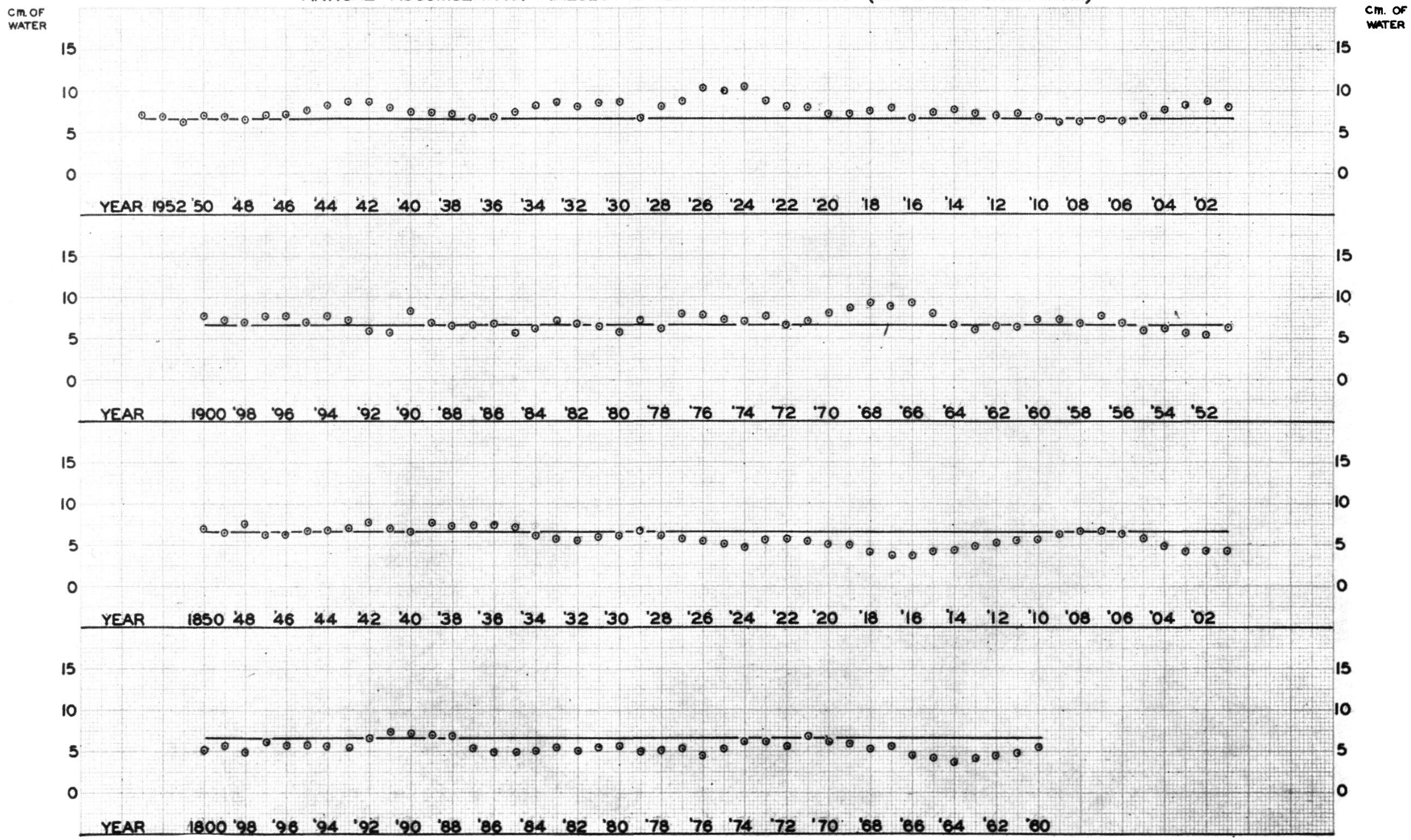


FIGURE 22
ANNUAL ACCUMULATION VALUES 5-YEAR RUNNING MEAN (PIT 5 AND SNOW MINE)



ACCUMULATION DATA

TABLE 19

Snow Mine, 24 April - 7 November 1958

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm³	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1947	11	206.0	220.0	14.0	.382	5.3		
1946	12	220.0	242.0	22.0	.382	8.4		
1945	13	242.0	261.0	19.0	.395	7.5		
1944	14	261.0	277.0	16.0	.404	6.5		
1943	15	277.0	296.0	19.0	.404	7.7	Value from Pit #5 (111.0)	
1942	16	296.0	318.0	22.0	.407	9.0	120.0	7.5
1941	17	318.0	327.0	9.0	.408	3.7	123.7	7.3
1940	18	327.0	344.0	17.0	.408	6.9	130.6	7.3
1939	19	344.0	367.0	23.0	.416	9.6	140.2	7.4
1938	20	367.0	385.0	18.0	.419	7.5	147.7	7.4
1937	21	385.0	399.0	14.0	.419	5.9	153.6	7.3
1936	22	399.0	409.0	10.0	.422	4.2	157.8	7.2
1935	23	409.0	433.0	24.0	.422	10.1	167.9	7.3
1934	24	433.0	465.0	32.0	.422	13.5	181.4	7.6
1933	25	465.0	486.0	21.0	.421	8.8	190.2	7.6
1932	26	486.0	495.0	9.0	.421	3.8	194.0	7.5
1931	27	495.0	510.0	15.0	.432	6.5	200.5	7.4
1930	28	510.0	534.0	24.0	.438	10.5	211.0	7.5
1929	29	534.0	543.0	9.0	.438	3.9	214.9	7.4
1928	30	543.0	577.0	34.0	.451	15.3	230.2	7.7
1927	31	577.0	594.0	17.0	.452	7.7	237.9	7.7
1926	32	594.0	625.0	31.0	.450	14.0	251.9	7.9
1925	33	625.0	645.0	20.0	.449	9.0	260.9	7.9
1924	34	645.0	658.0	13.0	.452	5.9	266.8	7.8
1923	35	658.0	673.0	15.0	.454	6.8	273.6	7.8
1922	36	673.0	682.0	9.0	.454	4.1	277.7	7.7
1921	37	682.0	712.0	30.0	.458	13.7	291.4	7.9
1920	38	712.0	723.0	11.0	.464	5.1	296.5	7.8
1919	39	723.0	737.0	14.0	.464	6.5	303.0	7.8
1918	40	730.0	747.0	17.0	.464	7.9	310.9	7.8
1917	41	747.0	761.0	14.0	.467	6.5	317.4	7.7
1916	42	761.0	777.0	16.0	.468	7.5	324.9	7.7
1915	43	777.0	794.0	17.0	.468	8.0	332.9	7.7
1914	44	793.0	811.0	18.0	.475	8.6	341.5	7.8
1913	45	811.0	823.0	12.0	.479	5.7	347.2	7.7
1912	46	823.0	834.0	11.0	.479	5.3	352.5	7.7
1911	47	834.0	853.0	19.0	.480	9.1	361.6	7.7
1910	48	853.0	863.5	10.5	.487	5.1	366.7	7.6

TABLE 19
(Continued)

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1909	49	863.5	874.0	10.5	.487	5.1	371.8	7.6
1908	50	874.0	887.0	13.0	.487	6.3	378.1	7.6
1907	51	887.0	902.0	15.0	.487	7.3	385.4	7.6
1906	52	902.0	919.0	17.0	.489	8.3	393.7	7.6
1905	53	918.0	934.0	16.0	.489	7.8	401.5	7.6
1904	54	934.0	951.5	17.5	.489	8.6	410.1	7.6
1903	55	951.5	971.0	19.5	.484	9.4	419.5	7.6
1902	56	971.0	989.0	18.0	.484	8.7	428.2	7.6
1901	57	989.0	1000.0	11.0	.484	5.3	433.5	7.6
1900	58	1000.0	1013.0	13.0	.496	6.4	439.9	7.6
1899	59	1013.0	1026.0	13.0	.496	6.4	446.3	7.6
1898	60	1026.0	1043.0	17.0	.496	8.4	454.7	7.6
1897	61	1043.0	1066.5	23.5	.496	11.7	466.4	7.6
1896	62	1066.5	1078.0	11.5	.496	5.7	472.1	7.6
1895	63	1084.0	1090.0	6.0	.496	3.0	475.1	7.5
1894	64	1090.0	1108.0	18.0	.500	9.0	484.1	7.6
1893	65	1108.0	1122.0	14.0	.506	7.1	491.2	7.6
1892	66	1122.0	1131.0	9.0	.506	4.6	495.8	7.5
1891	67	1131.0	1141.0	10.0	.506	5.1	500.9	7.5
1890	68	1141.0	1173.0	32.0	.511	16.4	517.3	7.6
1889	69	1173.0	1176.0	3.0	.513	1.5	518.8	7.5
1888	70	1176.0	1186.0	10.0	.513	5.1	523.9	7.5
1887	71	1189.0	1199.0	10.0	.511	5.1	529.0	7.5
1886	72	1199.0	1210.0	11.0	.520	5.7	534.7	7.4
1885	73	1210.0	1232.0	22.0	.509	11.2	545.9	7.5
1884	74	1232.0	1238.5	6.5	.488	3.2	549.1	7.4
1883	75	1238.5	1259.0	20.5	.497	10.2	559.3	7.5
1882	76	1259.0	1265.0	6.0	.511	3.1	562.4	7.4
1881	77	1265.0	1275.0	10.0	.496	5.0	567.4	7.4
1880	78	1275.0	1291.5	16.5	.498	8.2	575.6	7.4
1879	79	1291.5	1311.0	19.5	.510	9.9	585.5	7.4
1878	80	1311.0	1321.0	10.0	.486	4.9	590.4	7.4
1877	81	1317.0	1341.0	24.0	.499	12.0	602.4	7.4
1876	82	1341.0	1349.0	8.0	.519	4.2	606.6	7.4
1875	83	1349.0	1359.0	10.0	.520	5.2	611.8	7.4
1874	84	1359.0	1376.0	17.0	.521	8.9	620.7	7.4
1873	85	1376.0	1390.5	14.5	.534	7.7	628.4	7.4
1872	86	1390.5	1404.5	14.0	.523	7.3	635.7	7.4
1871	87	1404.5	1417.0	12.5	.516	6.5	642.2	7.4
1870	88	1417.0	1436.0	19.0	.523	9.9	652.1	7.4
1869	89	1436.0	1459.5	23.5	.533	12.5	664.6	7.5
1868	90	1459.5	1479.5	20.0	.526	10.5	675.1	7.5
1867	91	1479.5	1489.0	9.5	.517	4.9	680.0	7.5

TABLE 19
(Continued)

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1866	92	1491.0	1508.0	17.0	.522	8.9	688.9	7.5
1865	93	1508.0	1514.0	6.0	.530	3.2	692.1	7.4
1864	94	1514.0	1525.0	11.0	.510	5.6	697.7	7.4
1863	95	1525.0	1540.0	15.0	.524	7.9	705.6	7.4
1862	96	1540.0	1552.5	12.5	.532	6.7	712.3	7.4
1861	97	1552.5	1568.5	16.0	.524	8.4	720.7	7.4
1860	98	1568.5	1584.0	15.5	.524	8.1	728.8	7.4
1859	99	1584.0	1594.0	10.0	.536	5.4	734.2	7.4
1858	100	1594.0	1605.0	11.0	.539	5.9	740.1	7.4
1857	101	1605.0	1625.0	20.0	.542	10.8	750.9	7.4
1856	102	1628.0	1636.0	8.0	.540	4.3	755.2	7.4
1855	103	1636.0	1642.5	6.5	.528	3.4	758.6	7.4
1854	104	1642.5	1655.0	12.5	.525	6.6	765.2	7.4
1853	105	1655.0	1660.0	5.0	.541	2.7	767.9	7.3
1852	106	1660.0	1678.5	18.5	.530	9.8	777.7	7.3
1851	107	1678.5	1695.5	17.0	.539	9.2	786.9	7.4
1850	108	1695.5	1708.0	12.5	.543	6.8	793.7	7.3
1849	109	1708.0	1715.0	7.0	.539	3.8	797.5	7.3
1848	110	1715.0	1729.5	14.5	.549	8.0	805.5	7.3
1847	111	1729.5	1736.5	7.0	.543	3.8	809.3	7.3
1846	112	1736.5	1752.0	15.5	.558	8.6	817.9	7.3
1845	113	1752.0	1768.0	16.0	.541	8.7	826.6	7.3
1844	114	1760.0	1768.0	8.0	.551	4.4	831.0	7.3
1843	115	1768.0	1785.0	17.0	.548	9.3	840.3	7.3
1842	116	1785.0	1799.0	14.0	.561	7.9	848.2	7.3
1841	117	1799.0	1807.5	8.5	.546	4.6	852.8	7.3
1840	118	1807.5	1819.5	12.0	.549	6.6	859.4	7.3
1839	119	1819.5	1837.0	17.5	.545	9.5	868.9	7.3
1838	120	1837.0	1851.5	14.5	.559	8.1	877.0	7.3
1837	121	1852.0	1867.0	15.0	.551	8.3	885.3	7.3
1836	122	1867.0	1875.0	8.0	.546	4.4	889.7	7.3
1835	123	1875.0	1885.0	10.0	.548	5.5	895.2	7.3
1834	124	1885.0	1893.0	8.0	.543	4.3	899.5	7.3
1833	125	1893.0	1904.0	11.0	.543	6.0	905.5	7.2
1832	126	1904.0	1917.5	13.5	.556	7.5	913.0	7.2
1831	127	1917.5	1929.5	12.0	.562	6.7	919.7	7.2
1830	128	1929.5	1942.5	13.0	.555	7.2	926.9	7.2
1829	129	1943.0	1954.5	11.5	.558	6.4	933.3	7.2
1828	130	1954.5	1959.0	4.5	.562	2.5	935.8	7.2
1827	131	1959.0	1970.5	11.5	.557	6.4	942.2	7.2
1826	132	1970.5	1980.0	9.5	.549	5.2	947.4	7.2
1825	133	1980.0	1989.0	9.0	.548	4.9	952.3	7.2
1824	134	1989.0	1997.0	8.0	.559	4.5	956.8	7.1

TABLE 19
(Continued)

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1823	135	1997.0	2012.0	15.0	.548	8.2	965.0	7.1
1822	136	2012.0	2022.5	10.5	.563	5.9	970.9	7.1
1821	137	2022.5	2029.0	6.5	.563	3.7	974.6	7.1
1820	138	2029.0	2035.0	6.0	.571	3.4	978.0	7.1
1819	139	2035.0	2042.0	7.0	.569	4.0	982.0	7.1
1818	140	2040.5	2047.0	6.5	.563	3.7	985.7	7.0
1817	141	2047.0	2054.0	7.0	.564	3.9	989.6	7.0
1816	142	2054.0	2061.5	7.5	.565	4.2	993.8	7.0
1815	143	2061.5	2071.5	10.0	.556	5.6	999.4	7.0
1814	144	2071.5	2080.0	8.5	.552	4.7	1004.1	7.0
1813	145	2087.0	2098.0	11.0	.563	6.2	1010.3	7.0
1812	146	2098.0	2108.0	10.0	.557	5.6	1015.9	7.0
1811	147	2108.0	2119.0	11.0	.551	6.1	1022.0	7.0
1810	148	2119.0	2129.0	10.0	.562	5.6	1027.6	6.9
1809	149	2129.0	2143.5	14.5	.560	8.1	1035.7	7.0
1808	150	2143.5	2156.5	13.0	.569	7.4	1043.1	7.0
1807	151	2162.0	2173.0	11.0	.551	6.1	1049.2	6.9
1806	152	2173.0	2182.0	9.0	.537	4.8	1054.0	6.9
1805	153	2182.0	2187.0	5.0	.537	2.7	1056.7	6.9
1804	154	2187.0	2193.0	6.0	.553	3.3	1060.0	6.9
1803	155	2193.0	2201.5	8.5	.570	4.8	1064.8	6.9
1802	156	2201.5	2211.5	10.0	.573	5.7	1070.5	6.9
1801	157	2211.5	2220.0	8.5	.580	4.9	1075.4	6.8
1800	158	2220.0	2231.5	11.5	.570	6.6	1082.0	6.8
1799	159	2231.5	2243.0	11.5	.566	6.5	1088.5	6.8
1798	160	2243.0	2253.0	10.0	.563	5.6	1094.1	6.8
1797	161	2253.0	2266.0	13.0	.566	7.4	1101.5	6.8
1796	162	2266.0	2271.5	5.5	.564	3.1	1104.6	6.8
1795	163	2271.5	2282.5	11.0	.560	6.2	1110.8	6.8
1794	164	2286.0	2296.5	10.5	.562	5.9	1116.7	6.8
1793	165	2296.5	2340.0	7.5	.570	4.3	1121.0	6.8
1792	166	2304.0	2329.0	25.0	.566	14.2	1135.2	6.8
1791	167	2329.0	2304.5	11.5	.566	6.5	1141.7	6.8
1790	168	2340.5	2349.0	8.5	.577	4.9	1146.6	6.8
1789	169	2349.0	2358.0	9.0	.573	5.2	1151.8	6.8
1788	170	2358.0	2364.0	6.0	.566	3.4	1155.2	6.8
1787	171	2364.0	2376.0	12.0	.582	7.0	1162.2	6.8
1786	172	2376.0	2384.0	8.0	.574	4.6	1166.8	6.8
1785	173	2384.0	2391.0	7.0	.586	4.1	1170.9	6.8
1784	174	2391.0	2402.0	11.0	.582	6.4	1177.3	6.8
1783	175	2393.0	2402.0	9.0	.580	5.2	1182.5	6.8
1782	176	2402.0	2410.0	8.0	.575	4.6	1187.1	6.7

TABLE 19
(Continued)

Accumulation Year	Year No.	Top cm.	Bottom cm.	Cm. of Snow	Avg. Density gm/cm^3	Annual Accum. Water Equiv. cm.	Cumulative Accum. in cm. of Water	Avg. Annual Accum. in cm. of Water
1781	177	2410.0	2422.5	12.5	.570	7.1	1194.2	6.7
1780	178	2422.5	2430.5	8.0	.577	4.6	1198.8	6.7
1779	179	2430.5	2436.5	6.0	.575	3.5	1202.3	6.7
1778	180	2436.5	2446.0	9.5	.576	5.5	1207.8	6.7
1777	181	2446.0	2456.5	10.5	.571	6.0	1213.8	6.7
1776	182	2456.5	2461.5	5.0	.573	2.9	1216.7	6.7
1775	183	2461.5	2477.5	16.0	.574	9.2	1225.9	6.7
1774	184	2488.0	2500.0	12.0	.581	7.0	1232.9	6.7
1773	185	2500.0	2510.0	10.0	.571	5.7	1238.6	6.7
1772	186	2510.0	2515.5	5.5	.579	3.2	1241.8	6.7
1771	187	2515.5	2531.5	16.0	.576	9.2	1251.0	6.7
1770	188	2531.5	2541.0	9.5	.579	5.5	1256.5	6.7
1769	189	2541.0	2552.0	11.0	.588	6.5	1263.0	6.7
1768	190	2552.0	2556.5	4.5	.585	2.6	1265.6	6.7
1767	191	2556.5	2563.5	7.0	.584	4.1	1269.7	6.6
1766	192	2563.5	2571.0	7.5	.582	4.4	1274.1	6.6
1765	193	2571.0	2576.5	5.5	.581	3.2	1277.3	6.6
1764	194	2576.5	2583.5	7.0	.588	4.1	1281.4	6.6
1763	195	2583.5	2592.0	8.5	.588	5.0	1286.4	6.6
1762	196	2590.5	2600.0	9.5	.587	5.6	1292.0	6.6
1761	197	2600.0	2610.5	10.5	.590	6.2	1298.2	6.6
1760	198	2610.5	2623.0	12.5	.587	7.3	1305.5	6.6

FIGURE 23

DENSITY-DEPTH CURVE, INDICATING SOURCE OF SAMPLES

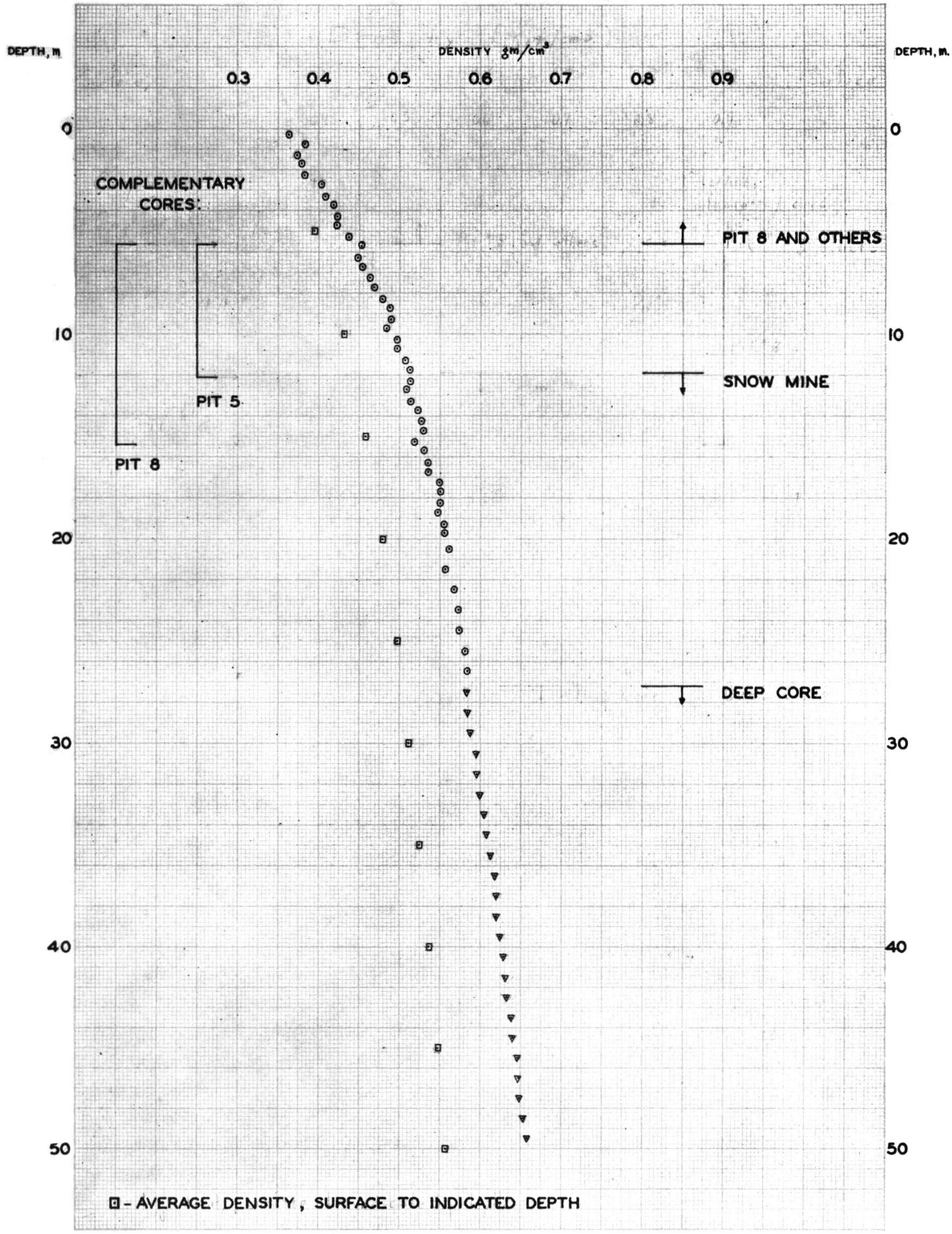


TABLE 20

DEPTH-DENSITY VALUES

(Computed from Pits #1 to #8, Snow Mine and Deep Core)

Depth m.	No. of Study Sites	Total cm. Sampled	Avg. Density kgm/cm^3	Depth m.	No. of Study Sites	Total cm. Samples	Avg. Density kgm/cm^3
0.0- 0.5	8	372.0	.362	20.0-21.0	1	105.0	.561
0.5- 1.0	8	360.0	.383	21.0-22.0	1	105.0	.556
1.0- 1.5	8	360.0	.374	22.0-23.0	1	97.5	.567
1.5- 2.0	5	234.0	.379	23.0-24.0	1	97.5	.573
2.0- 2.5	5	228.0	.382	24.0-25.0	1	97.5	.574
2.5- 3.0	5	216.0	.404	25.0-26.0	1	97.5	.581
3.0- 3.5	1	48.0	.408	26.0-27.0	1	97.5	.584
3.5- 4.0	1	42.0	.419	27.0-28.0	1	96.0	.583
4.0- 4.5	1	48.0	.422	28.0-29.0	1	96.5	.584
4.5- 5.0	1	48.0	.421	29.0-30.0	1	97.5	.587
5.0- 5.5	1	48.0	.438	30.0-31.0	1	95.5	.595
5.5- 6.0	2	92.0	.452	31.0-32.0	1	97.0	.596
6.0- 6.5	2	89.0	.449	32.0-33.0	1	96.0	.600
6.5- 7.0	2	91.5	.454	33.0-34.0	1	95.5	.605
7.0- 7.5	2	96.0	.464	34.0-35.0	1	96.5	.607
7.5- 8.0	2	96.0	.468	35.0-36.0	1	96.5	.612
8.0- 8.5	2	96.0	.479	36.0-37.0	1	95.5	.617
8.5- 9.0	2	96.0	.487	37.0-38.0	1	94.5	.620
9.0- 9.5	2	96.0	.489	38.0-39.0	1	94.0	.620
9.5-10.0	2	92.0	.484	39.0-40.0	1	97.0	.625
10.0-10.5	2	96.0	.496	40.0-41.0	1	96.5	.628
10.5-11.0	2	97.0	.496	41.0-42.0	1	96.0	.630
11.0-11.5	2	96.0	.506	42.0-43.0	1	93.5	.633
11.5-12.0	2	96.0	.513	43.0-44.0	1	98.0	.639
12.0-12.5	2	96.0	.512	44.0-45.0	1	97.5	.640
12.5-13.0	2	98.0	.508	45.0-46.0	1	96.5	.646
13.0-13.5	2	93.5	.513	46.0-47.0	1	91.0	.647
13.5-14.0	2	98.0	.522	47.0-48.0	1	95.0	.649
14.0-14.5	2	91.5	.527	48.0-49.0	1	95.5	.653
14.5-15.0	2	97.0	.529	49.0-50.0	1	84.5	.658
15.0-15.5	2	87.0	.518				
15.5-16.0	1	50.0	.530				
16.0-16.5	1	50.0	.535				
16.5-17.0	1	50.0	.535				
17.0-17.5	1	50.0	.549				
17.5-18.0	1	45.0	.550				
18.0-18.5	1	50.0	.550				
18.5-19.0	1	45.0	.547				
19.0-19.5	1	50.0	.555				
19.5-20.0	1	45.0	.555				

Snow Accumulation

Network "A": Periodic Observations

To obtain values of snow accumulation a network of 55 wooden dowels (.5 cm. in diameter) were placed and leveled 250 m. windward of PS on 13 January 1958. The network consisted of five rows of eleven dowels each with a distance of 6 m. between dowels and rows, covering 1440 m^2. The network was oriented perpendicular to the prevailing winds. Each dowel was read to the nearest 0.5 cm., but the average of the network is given to 0.1 cm.

TABLE 21

Snow Accumulation; Periodic Values

(Values in Centimeters)

Date 1958		Accumulation	Total Since 13 January 1958	Individual Extreme Values Max. Gain	Max. Loss
January	13	0.0	0.0		
	26	0.8	0.8	5.5	- 4.5
February	4	0.3	1.1	4.0	- 0.5
	19	5.1	6.2	15.5	- 0.5
March	2	2.1	8.3	9.5	- 2.0
	15	1.2	9.5	17.0	- 1.5
	28	1.2	10.7	16.0	- 5.0
May	1	1.9	12.6	17.5	- 6.0
	11	1.0	13.6	15.5	-11.5
	23	-1.5	12.1	16.0	-20.5
	27	0.3	12.4	20.5	-16.0
June	1	1.5	13.9	11.5	- 9.5
	12	1.8	15.7	17.0	- 8.0
	24	-0.7	15.0	15.0	-16.5
	30	0.7	15.7	23.0	-11.0
July	31	3.3	19.0	15.5	-15.0
August	16	-0.2	18.8	7.5	- 9.0
	24	0.6	19.4	19.0	- 9.0
	30	-0.2	19.2	11.5	- 9.0
September	9	0.9	20.1	26.0	-11.0
	15	-0.3	19.8	10.0	-19.0
	26	1.2	21.0	21.0	-10.0
October	2	1.6	22.6	20.5	-14.0
	13	-0.4	22.2	17.0	-21.0
	15	0.2	22.4	16.0	-15.0
	22	0.8	23.2	13.0	- 2.0
	31	1.0	24.2	30.0	-12.5
November	5	0.2	24.4	10.5	- 6.0
	15	0.2	24.6	3.0	- 1.0

The accumulation values given in Table 21 are plotted in Fig. 24. A marked increase of snow accumulation occurred in February. It is worthy of note that some of the maximum gain and loss values recorded at individual dowels, are as large as the total annual snow accumulation.

Due to the large amount of unconsolidated accumulation at the end of the winter, a greater proportion of dowels showed remarkably high gain and loss values. The contrary was observed for summer accumulation. For example: the visible flake type precipitation of 21 November, the first "snow fall" the writer observed since early February, consolidated relatively fast because of more favorable radiation, air temperature and relative humidity conditions. Although the wind speed was not as high as during the winter, this layer was not as easily deflated as the winter layers. In Fig. 25, the snow accumulation values for four dowels are given, each dowel being representative of extreme variations of snow accumulation at a given point. During the period 13 January-15 November the maximum snow accumulation was recorded, 46 cm., at dowel #206 (see Fig. 26 for location). The minimum snow accumulation, 12 cm., was recorded at dowel #505. The maximum periodic gain was registered at dowel #306 between 22 and 31 October, with an accumulation rate of 3 cm./day. The maximum loss was registered at dowel #408, between 2 and 13 October, with a loss rate of 2 cm./day. However, both of these gain and loss rates are smaller than those recorded at dowels #202 and #307, between 13 and 15 October, when a gain of 8 cm./day and a loss of 7 cm./day were observed.

The network of 55 dowels is shown schematically in Fig. 26. The snow accumulation recorded at each dowel between 13 January and 15 November 1958 is shown in vertical columns which vary in height as to the amount of accumulation. The amount of accumulation at each dowel is shown in relation to the mean surface level of 13 January and 15 November.

The accumulation-deflation data are not presented in surface contours because in the 36 m^2 contained between each four dowels there were surface features such as deflation pockets and sastrugi. Outstanding surface features were observed within the limits of the network "A." Between dowels #305 and #406 there was a 0.5 m^2 surface section where an iced crust formed in late January or early February remained uncovered from 19 February to 31 October. Between dowels #107 and #108 there was an anvil shaped corrasion form approximately 30 cm. high; the tail of the formation reached between dowels #207 and #208. From early August to mid-October the anvil horn receded until it disappeared between dowels #207 and #208; the tail of the formation reached approximately half way to the next row of dowels. These were exceptions in the general picture of the rapidly changing surface features.

FIGURE 24
SNOW ACCUMULATION, NETWORK "A", 1958

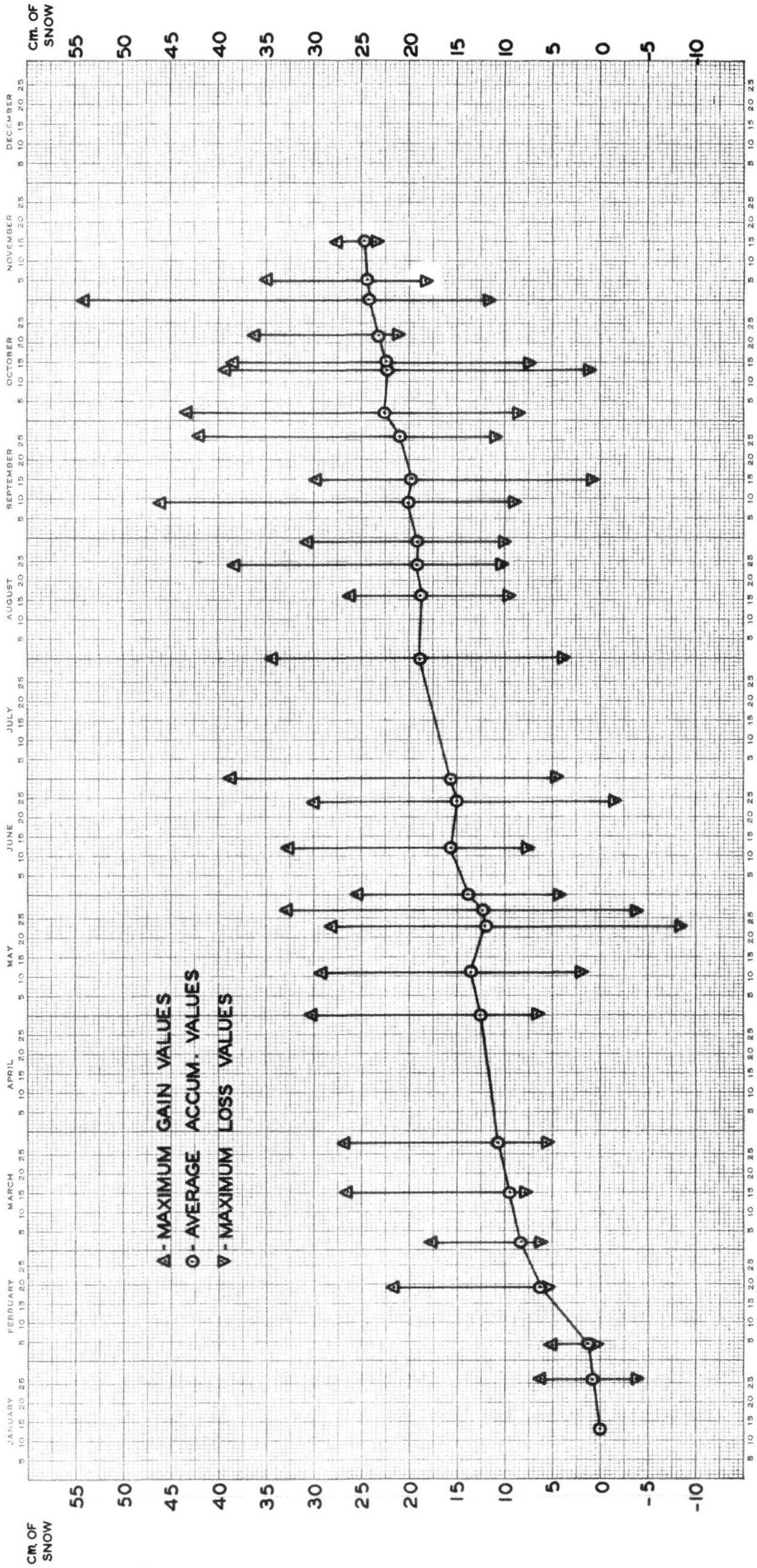


FIGURE 25

SNOW ACCUMULATION, 1958 - PARTICULAR DOWELS

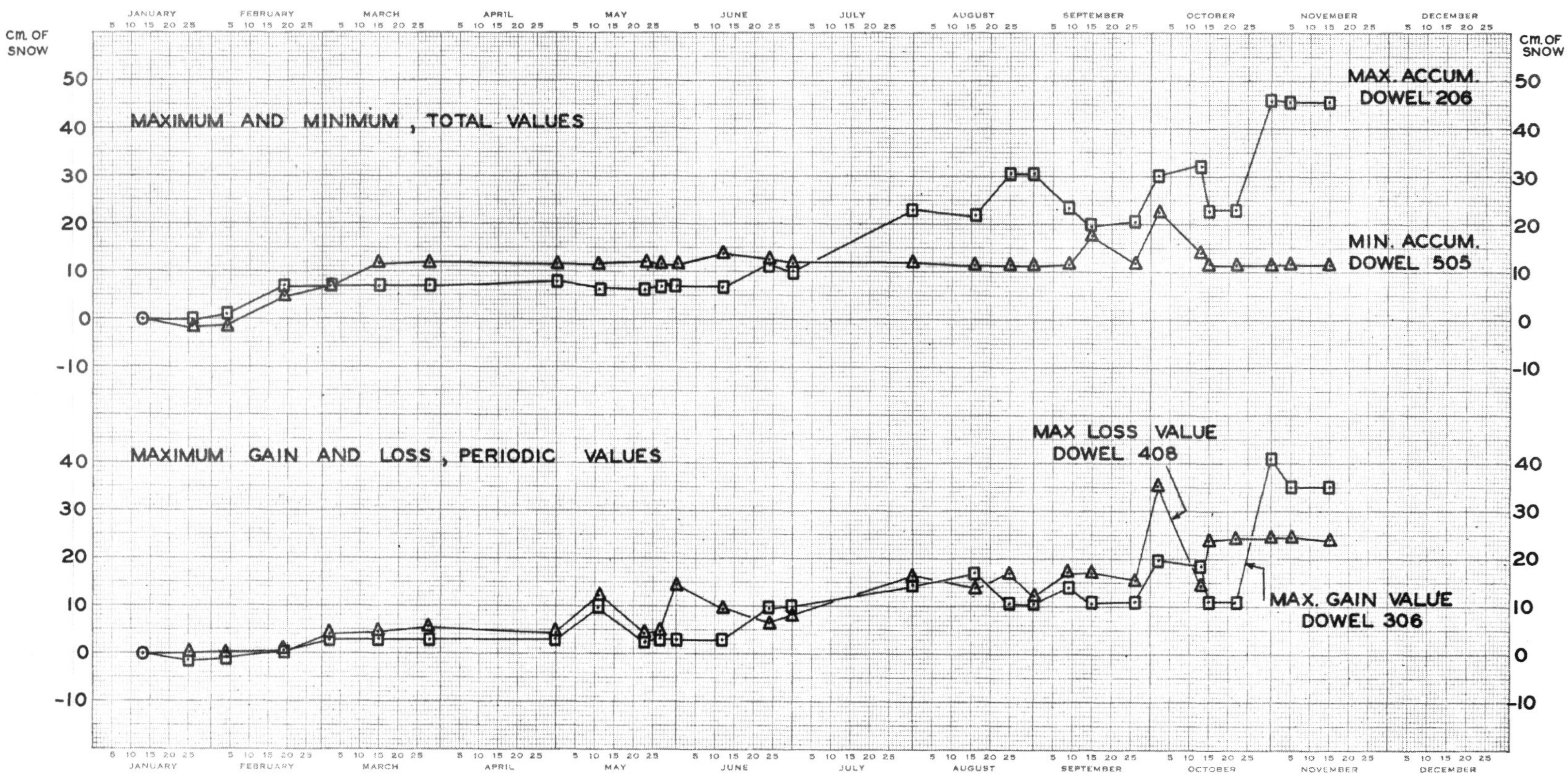
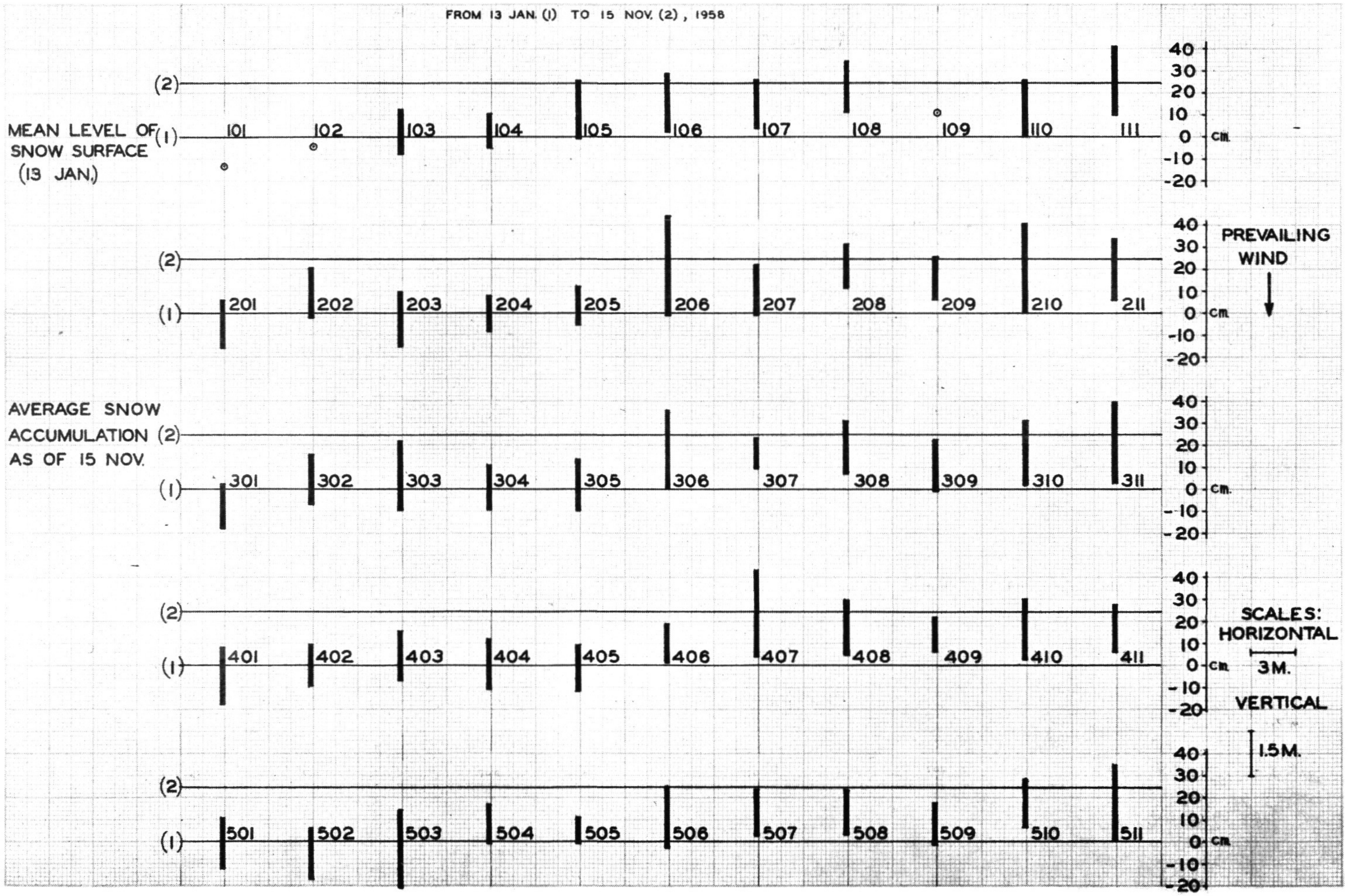


FIGURE 26

SNOW ACCUMULATION , NETWORK "A"



Network "B": Seasonal Observations

To obtain seasonal snow accumulation values six stakes (5 x 5 cm.) and 36 bamboo poles (2.5 cm. in diameter) were emplaced on 14 and 27 January 1958. Stakes and poles were placed at 300 m. intervals along a 12.6 km. run of a pentagonal pattern. The center of this network was located 3 km. windward of PS. The stakes and poles were measured only once by the writer on 5 November 1958.

TABLE 22

Snow Accumulation; Seasonal Values

(Values in Centimeters)

	Period	Avg. Snow Accum.	Extreme Single Values Max.	Min.
Stakes A to F	14 Jan. - 5 Nov.	23.2	35.0	2.0
Poles #1 to #36	27 Jan. - 5 Nov.	22.0	52.5	8.0

In the given periods, the accumulation values observed at Stakes A to F and at Poles #1 to #36 are 1.2 and 1.6 cm. respectively, below the amount of accumulation observed in network "A."

Firn Temperature

Periodic Observations

At PS a joint coverage of deep firn temperatures was arranged between the glaciology, micrometeorology and United States Weather Bureau personnel.

Micrometeorology and USWB were to record constantly the temperature at the following depths: 0, 2, 5, 10, 25, 50, 100, 250, and 800 cm.

The temperature at 150, 200, 250, 300, 500, and 1200 cm. depths was taken by glaciology. As the temperature at these depths was not as critical as the near surface temperature, readings were taken only every three days. Readings were taken for the period 19 January to 15 November and the schedule was met regularly except for January. On 15 January 1958, six thermohms were placed 120 m. windward of PS at depths 10 cm. above those indicated. A depth correction can be applied to each level for any observation by referring to the snow accumulation registered in network "A," noted earlier in this report. By 15 November 1958, the date of the last temperature reading, the thermohm leads were at depths 15 cm. below those indicated. The area's snow accumulation for the period 15 January - 15 November was approximately 25 cm.

The six thermohm leads were placed in separate bored holes, 10 cm. in diameter, and covered with dry powder snow up to the surface. They were connected to a junction box at the surface and a single thermohm wire 150 m. long connected the system to a Wheatstone bridge inside a building where the temperatures were read.

The bridge dial is graduated to 0.2°C.; the observer visually narrowed the readings to eighths of each division and the temperatures were noted to the nearest 0.025°C., the reading accuracy being ± 0.01°C. Before being emplaced the thermohms were tested for accuracy in an alcohol bath at different temperatures between 0 and -25°C. in order to obtain a correction factor. The corrections varied from -0.08 to +0.12°C. Corrections have been applied to the values used in the following table and figures. The bridge was periodically checked with a calibration coil. Errors introduced, e.g., when the bridge is exposed to sudden air temperature changes,* when it is not level or it is shaken by the wind, were eliminated by its installation inside a building. The bridge dial would "freeze" at -50°C. and the junction box switch would become inoperative at -65°C.

The temperature values given in the following table which were taken by micrometeorologist P. Dalrymple** and meteorologist K. Hanson*** are

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*Uneven temperature distribution inside the bridge may affect the variable resistors.

**U. S. Army, Quartermaster Corps Research and Engineering Command.

***United States Weather Bureau.

subject to revision by their respective agencies after further analysis. These temperatures were read to 0.1°F. and converted to degrees centigrade to the nearest tenth.

In Table 23 which follows, all temperatures are in -°C.; column 1 indicates month and day when observations were made; column 2, the time of observation, in GMT; column 3 indicates a depth correction to be applied for that day only to the shallow depths recorded by micrometeorology; other columns where temperature values are given, are headed by indications of depth and source.

The temperature-depth profiles in Fig. 27 are representative on two accounts. First, they comprise two periods (3 February - 15 April and 12 September - 3 November) when extreme temperature values were observed at the levels recorded by glaciology. Second, at levels not affected by minor temperature fluctuations within a particular season, they show the greater inversions caused by preceding seasons.

The increase of annual temperature range toward the surface is illustrated in Fig. 28; the actual temperature readings for each given depth are plotted in Figs. 29 to 31.

Deep Firn Temperatures

To measure temperature, horizontal holes were drilled 6 m. in the west wall of the Snow Mine at depths of 12, 16, 20 and 24 m. Temperature observations were continued in the augered hole where the Deep Core was obtained; there, readings were taken at depths of 31, 36, 41, 45, and 50 m. The period of observation for depths from 12 to 50 m. was 17 - 27 September.

There is a difference of 0.05°C. between the temperature values observed at a depth of 12 m. from the surface at the 12 m. level in the Snow Mine. A single lead was used at all depths in the Snow Mine to eliminate one source of error, and no correction was applied to the readings. If the 12 m. reading obtained with this lead is compared with the uncorrected 12 m. value obtained with the lead from the surface, the difference is reduced to 0.025°C. It should be pointed out that these two sites were 100 m. apart, and that the readings were taken two days apart.

Temperature inversions produced by preceding seasons were detectable back to the winter of 1957; other inversions at lower levels were too close to the observational error to be meaningful. The temperature gradient observed between depths of 20 and 50 m. annual accumulation accounted for, seem to indicate present warmer conditions than, say, one half century ago; however, deeper temperature values have to be available if secular climatic variations are to be inferred.

TABLE 23

FIRN TEMPERATURES

Surface to 12 Meters

1 m,d	2 GMT	3 cm	-5 cm. M	-25 cm. M	-50 cm. M	-100 cm. USWB	-150 cm. G	-200 cm. G	-250 cm. G	-300 cm. G	-500 cm. G	-800 cm. M	-1200 cm. G
1/19	2130					33.8	35.750	42.625	45.100	47.425	50.950		50.725
1/31	0000					33.8	35.625	41.500	43.975	46.475	50.450		50.800
2/3	0200					34.0	35.000	41.475	43.625	46.175	50.275		50.825
2/3	1900		28.4	30.6	31.7								
2/7	2400		34.4	32.7	32.7							51.8	
2/8	0230					34.5	35.925	41.225	43.275	45.725	49.975		50.825
2/12	0500		41.1	37.3	36.0							51.8	
2/12	0600					35.7	36.500	41.075	43.075	45.475	49.775		50.775
2/16	0400		43.3	40.9	39.4	37.7	37.500	41.150	42.900	45.275	49.625		50.825
2/18	0200	+12	29.8	37.6	38.7	38.3	38.100	41.200	42.875	45.225	49.575		50.825
2/19	0000	+12	29.6	35.3	37.7	38.3	38.4*	41.1*	42.9*	45.1*	49.6*		50.9*
2/20	0145	+ 3	29.6	33.6	35.8	37.9	38.4	41.1	42.8	45.0	49.6		50.9
2/21	0245	+ 4	36.0	34.3	35.6	37.7	38.4	41.1	42.8	45.0	49.5		50.9
2/22	0220		34.7	35.2	35.8	37.6	38.4	41.3	42.9	45.1	49.6	51.8	51.1
2/23	0240	+ 8	35.9	35.9	36.3	37.3	38.3	41.2	42.8	45.0	49.4		51.0
2/24	0235		39.2	36.9	36.9	37.3	38.3	41.2	42.8	44.9	49.4		50.8
2/25	0220	+10	35.9	37.1	36.8	37.3	38.1	41.2	42.8	44.9	49.4		50.7
2/26	0220					37.3	38.2	41.3	42.8	44.9	49.4		50.7
2/27	0125		40.4	36.9	37.1	37.7	38.4	41.2	42.8	44.9	49.3		50.7
3/2	0300		49.1	41.0	39.7								
3/6	0245		51.8	44.8	43.3	39.8	39.700	41.875	41.975	44.850	48.950		50.975
3/9	0330		49.2	45.9	45.0	41.2	40.750	42.075	43.125	44.875	48.900		50.975
3/12	0230		45.7	45.7	45.5	42.3	41.650	42.675	43.275	44.850	49.225		51.025
3/15	0330		60.8	49.2	47.1	42.7	42.125	42.675	43.525	44.825	48.625		51.025
3/17	0500		60.1	52.4	50.2	44.0	42.825	43.025	43.550	44.975	48.675		51.025

*Values given in these columns from 19-27 February were obtained using USWB recorder.

TABLE 23--Continued

FIRN TEMPERATURES

Surface to 12 Meters

1 m,d	2 GMT	3 cm	-5 cm. M	-25 cm. M	-50 cm. M	-100 cm. USWB	-150 cm. G	-200 cm. G	-250 cm. G	-300 cm. G	-500 cm. G	-800 cm. M	-1200 cm. G
3/18	0515		54.8	52.8	51.2	44.6	43.100	43.125	43.625	45.075	48.775	51.6	51.075
3/19	0530		54.7	51.9	51.1	45.2	43.575	43.250	43.725	45.250	48.675		51.175
3/20	0330		54.8	52.2	50.9	45.7	43.950	43.375	43.750	45.075	48.650		51.075
3/21	0500		49.9	51.1	50.6	45.9	44.225	43.500	43.900	45.050	48.525	51.4	51.025
3/22	0500		52.5	49.8	49.3	45.9	44.700	43.525	43.900	45.025	48.450		51.000
3/23	0700		63.6	52.1	50.4	46.1	44.775	43.800	43.950	45.275	48.525		51.075
3/24	0715		63.9	54.4	52.6	46.1	44.975	44.075	44.025	45.250		51.3	
3/25	0445		63.9	56.1	53.9	46.4	45.175	44.100	44.100	45.175			
3/26	0315		63.9	57.1	54.8	46.8	45.900	44.325	44.550	45.300			
3/31	0810		63.2	54.9	53.6		47.150	45.075	44.850	45.550	48.350	51.2	51.075
4/3	0230		64.7	57.5	55.8	49.6	47.725	45.650	45.075	45.725	48.375		51.075
4/6	0450		63.2	56.0	54.9	50.3	48.425	46.100	45.450	45.875			
4/9	0230		63.6	58.2	56.4	50.9	48.925	46.525	45.775	46.050	48.200	50.9	51.000
4/12	0330		62.9	58.4	57.0	51.8	49.750	47.100	46.175	46.275			
4/15	0530		64.3	59.4	58.0	52.6	50.250	47.450	46.450	46.475	48.125		50.925
4/18	0330					53.4	50.925	47.925	46.875	46.725			
4/21	0330		69.4	60.2	58.8	53.8	51.725	48.375	47.275	46.875	48.150		50.900
4/24	0730		65.5	59.8	58.9	54.3	52.100	48.775	47.550	47.250		50.8	
4/27	1730		62.2	60.0	59.3	54.8	52.550	49.350	48.025	47.550	48.200		50.925
4/30	0715		64.6	60.2	59.1	55.1	52.825	49.675	48.325	47.800		50.5	
5/3	1330	+ 5	55.7	59.2	59.1	55.5	53.200	50.100	48.650	48.050	48.275		50.850
5/6	0130		63.8	58.9	57.7	55.5	53.450	50.375	48.925	48.300			
5/9	1615		57.8	58.4	57.8	55.6	53.500	50.725	49.300	48.575	48.400	50.4	50.850
5/12	0440		59.2	59.2	57.9	55.6	53.500	50.950	49.500	48.750			
5/15	0730		57.1	56.2	56.2	55.3	53.575	51.150	49.900	49.000	48.575		50.825
5/18	2240		59.9	58.4	56.7	55.0	53.350	51.375	50.025	49.250			
5/21	1230		52.7	56.9	56.4	55.1	53.550	51.475	50.150	49.425	48.850	50.2	50.850

TABLE 23--Continued

FIRN TEMPERATURES

Surface to 12 Meters

1 m,d	2 GMT	3 cm	-5 cm. M	-25 cm. M	-50 cm. M	-100 cm. USWB	-150 cm. G	-200 cm. G	-250 cm. G	-300 cm. G	-500 cm. G	-800 cm. M	-1200 cm. G
5/24	0930					55.1	53.525	51.575	50.325	49.625			
5/27	0540		56.8	55.4	54.9	54.5	53.275	51.650	50.625	49.750	48.825	50.4	50.825
5/30	0310		59.8	59.0	56.3	54.6	53.100	51.700	50.550	49.875		50.4	
6/3	0730		55.7	57.1	57.5	55.0	53.450	51.725	50.650	50.050	49.050	50.2	50.825
6/6	0340		54.4	56.1	56.9	55.1	53.675	51.850	50.725	50.175		50.3	
6/9	0430		60.0	58.3	56.7	55.3	53.725	51.950	50.875	50.275	49.225	50.2	50.800
6/12	0325		58.4	59.8	58.5	55.5	53.800	52.075	50.975	50.375		50.2	
6/15*	0300		67.0	63.7	59.2	55.9	54.075	52.175	51.100	50.475	49.375	50.2	50.775
6/16	0300		68.4	64.4	59.9	56.2						50.2	
6/17	0300		70.4	64.4	60.8	56.4						50.3	
6/18	0300		68.6	65.5	61.4	56.6						50.3	
6/18	0730						54.575	52.350	51.175	50.600			
6/19	0300		72.1	67.5	61.8	57.1						50.2	
6/20	0300		71.5	67.3	62.7	57.7						50.2	
6/21	0300		71.7	68.3	63.1	57.9						50.2	
6/21	0330						55.325	52.575	51.350	50.700	49.500		50.750
6/22	0300		69.8	67.9	63.8	58.2						50.2	
6/23	0300		62.3	65.0	63.5	58.4						50.2	
6/24	0300		53.0	60.0	62.2	58.7						50.2	
6/24	0400						56.150	52.900	51.525	50.825			
6/27	2150		59.2	57.7	58.4	57.7	56.000	53.350	51.875	51.025	49.675	50.2	50.725
6/30	0330		65.3	61.6	59.1	57.3	55.725	53.525	52.050	51.225		50.2	
7/4	0320					56.9	55.675	53.675	52.275	51.400	49.825		50.725
7/6	0340		57.7	55.6	55.2	56.2	55.225	53.700	52.350	51.475		50.3	
7/9	0420		54.4	57.2	57.7	55.7	54.700	53.650	52.475	51.625	49.900	50.3	50.675

*June 15-24, World Meteorological Interval.

TABLE 23--Continued

FIRN TEMPERATURES

Surface to 12 Meters

1 m,d	2 GMT	3 cm	-5 cm. M	-25 cm. M	-50 cm. M	-100 cm. USWB	-150 cm. G	-200 cm. G	-250 cm. G	-300 cm. G	-500 cm. G	-800 cm. M	-1200 cm. G
7/12	0420	+15	61.8	59.2	57.3	56.0	54.675	53.625	52.500	51.725		50.4	
7/15	0530	+ 2	57.2	58.9	57.6	56.0	54.825	53.575	52.525	51.775	50.050	50.2	50.700
7/18	0340		60.0	57.9	56.6	56.3	54.900	53.600	52.550	51.875		50.2	
7/21	0430		57.6	56.9	56.6	56.1	54.825	53.625	52.600	51.950	50.250	50.2	50.675
7/24	0340		68.7	63.5	58.5	56.0	54.750	53.625	52.650	52.000		50.2	
7/27	0730	+ 4	60.8	60.2	58.9	56.4						50.0	
7/27	1940						55.225	53.650	52.725	52.075	50.350		50.650
7/30	2040	+ 7	52.5	52.6	54.1	55.9	55.250	53.750	52.725	52.125		50.6	
8/3	1920	+ 7	58.9	57.9	56.1	55.6	54.550	53.775	52.850	52.225	50.500	50.4	50.650
8/6	0330		66.1	64.0	58.4	56.3	54.600	53.725	52.850	52.250		50.2	
8/9	0415	+ 1	71.7	67.3	61.7	57.2	55.000	53.725	52.850	52.275		50.6	
8/12	0530	+ 2	62.5	60.3	60.1	57.8	55.700	53.750	52.850	52.300		50.2	
8/15	0330	+ 1	64.9	62.8	60.4	58.3	56.050	53.950	52.925	52.375	50.725	50.2	50.600
8/18	0330	+ 2	60.5	61.6	59.9	58.2	56.300	54.125	53.075	52.425		50.2	
8/21	0530		59.1	59.3	59.4	58.6	56.500	54.350	53.175	52.575	51.000	50.3	50.625
8/24	0400	+ 1	57.5	56.9	57.9	58.3	56.450	54.550	53.350	52.675		50.3	
8/27	0500	+ 1	62.4	60.8	58.4	58.1	56.175	54.625	53.475	52.775	50.900	50.4	50.600
8/31	0730		69.9	64.9	59.8	57.8	56.200	54.675	53.550	52.750		50.3	
9/3	0400		58.1	59.6	60.0	57.9	56.550	54.725	53.650	52.800	51.025	50.3	50.600
9/6	0430	+ 5	62.6	61.4	58.9							50.5	
9/6	2230					57.9	56.525	54.875	53.775	53.075			
9/9	0440	- 1	64.8	62.8	59.9	58.2	56.550	54.950	53.800	53.150	51.150	50.5	50.575
9/12	0340	+ 5	54.8	56.3	59.1	58.2	56.850	55.000	53.875	53.225		50.7	
9/15	0230	+ 5	50.2	52.6	56.5	57.9	56.650	55.100	53.950	53.275	51.250	50.5	50.600
9/18	0240		67.4	60.9	56.3	57.5	56.075	55.125	54.000	53.400		50.6	
9/21	0430					57.5	55.900	55.000	54.050	53.425	51.350		50.575
9/21	0500		69.7	66.2	60.3							50.7	

TABLE 23--Continued

FIRN TEMPERATURES

Surface to 12 Meters

1 m,d	2 GMT	3 cm	-5 cm. M	-25 cm. M	-50 cm. M	-100 cm. USWB	-150 cm. G	-200 cm. G	-250 cm. G	-300 cm. G	-500 cm. G	-800 cm. M	-1200 cm. G
9/24	0245	- 2	42.4	51.1	58.7	58.1	56.300	54.975	54.000	53.475		50.9	
9/27	0200					55.3	56.075	55.050	54.075	53.475	51.475		50.575
9/30	0345	+ 1	56.4	55.3	54.3	55.9	55.325	55.025	54.125	53.550		50.6	
10/3	0530		61.3	57.7	55.4	55.6	54.975	54.850	54.075	53.550	51.550	50.7	50.600
10/6	0215		60.2	57.5	56.2	55.4	54.925	54.675	54.000	53.525		50.6	
10/12	0520					54.4	56.000	54.625	53.925	53.550			
10/15	0530	+ 2	54.8	52.8	54.0	55.3	55.475	54.925	54.475	53.850	52.125	50.5	50.650
10/18	0400		51.9	53.5	54.1	53.6	54.875	54.700	54.050	53.700		50.3	
10/21	0400		44.9	50.8	54.2	53.7	54.725	54.600	53.975	53.675	52.000	50.5	50.750
10/24	0730		46.8	50.2	52.3	53.9	54.475	54.475	53.900	53.625		50.4	
10/27	0530		43.5	44.3	50.9							50.9	
10/27	2100					53.6	54.000	54.350	53.875	53.625	52.075		50.750
10/30	0500		36.8	40.8	48.3	53.6	53.500	54.200	53.775	53.575		50.5	
11/3	0530		42.8	44.0	47.9	52.2	52.350	53.850	53.625	53.500	52.125	50.8	50.725
11/6	0330		43.3	44.8	46.9	50.0	51.825	53.575	53.475	53.475		50.6	
11/9	1400		42.2	43.8	47.1							50.8	
11/12	0245		38.8	41.8	45.8		50.900	52.900		53.225		50.8	
11/12	2230					50.4			52.950				
11/15	0400					50.3	50.525	52.550	52.825	53.100	52.125		50.775
1959													
1/27	0100					36.0*			44.0*				

*Values received by message from PS.

FIGURE 27

FIRN TEMPERATURE - REPRESENTATIVE TEMPERATURE GRADIENTS

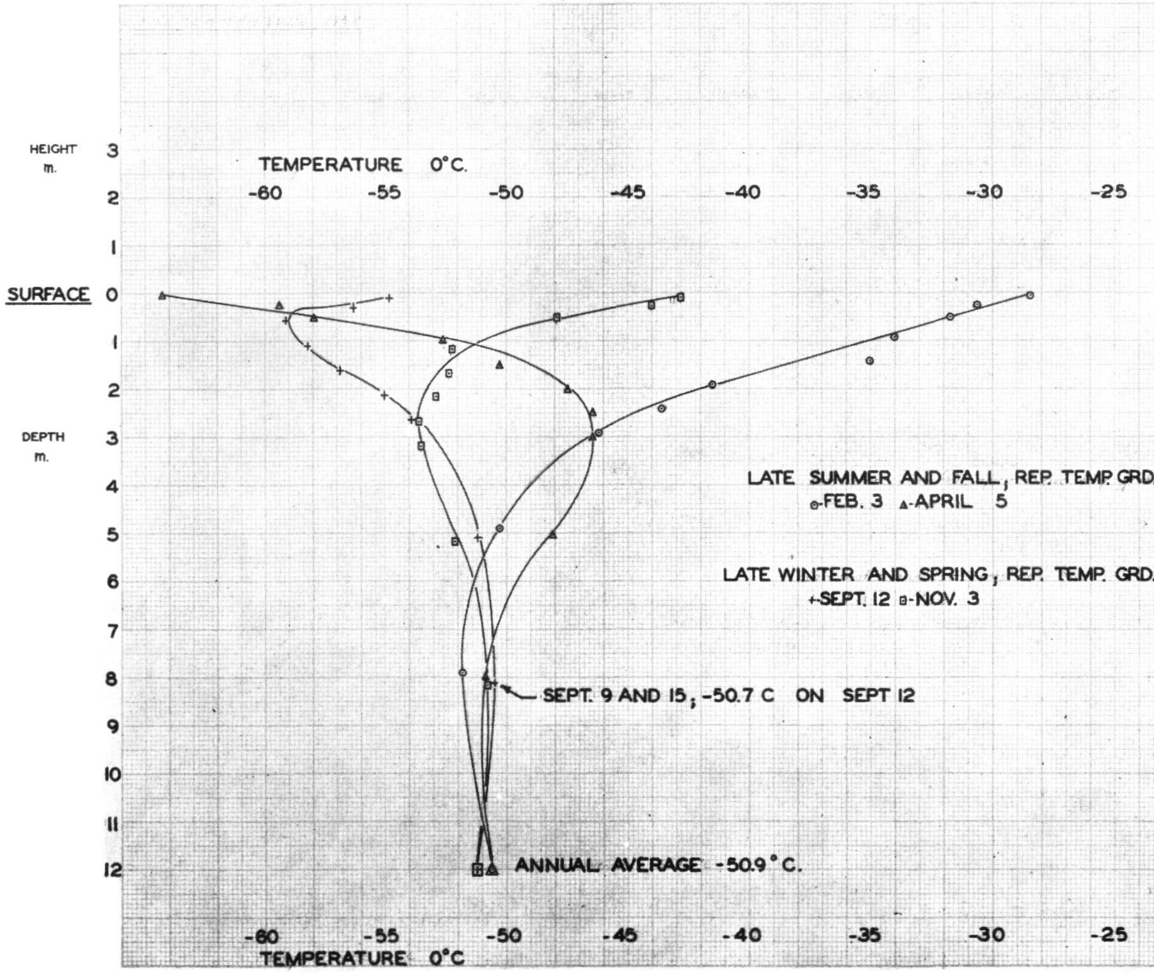


FIGURE 28

ANNUAL TEMPERATURE RANGE

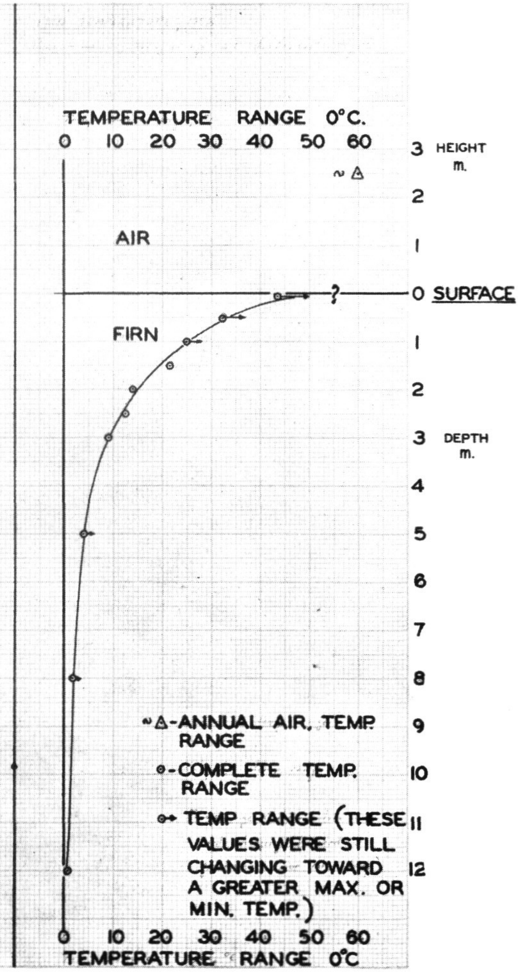


FIGURE 29
FIRN TEMPERATURE - ANNUAL VARIATION

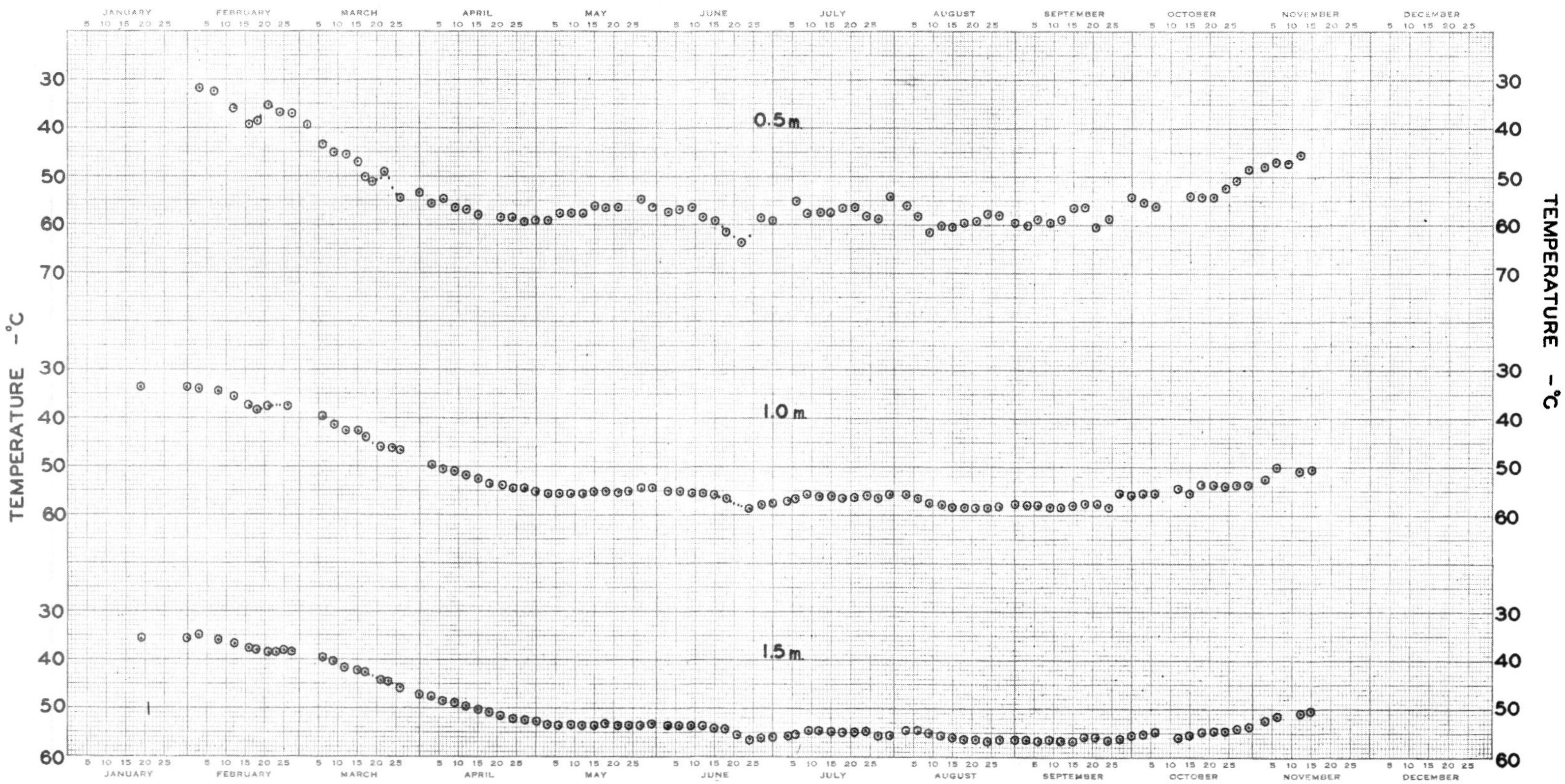


FIGURE 30

FIRN TEMPERATURE - ANNUAL VARIATION

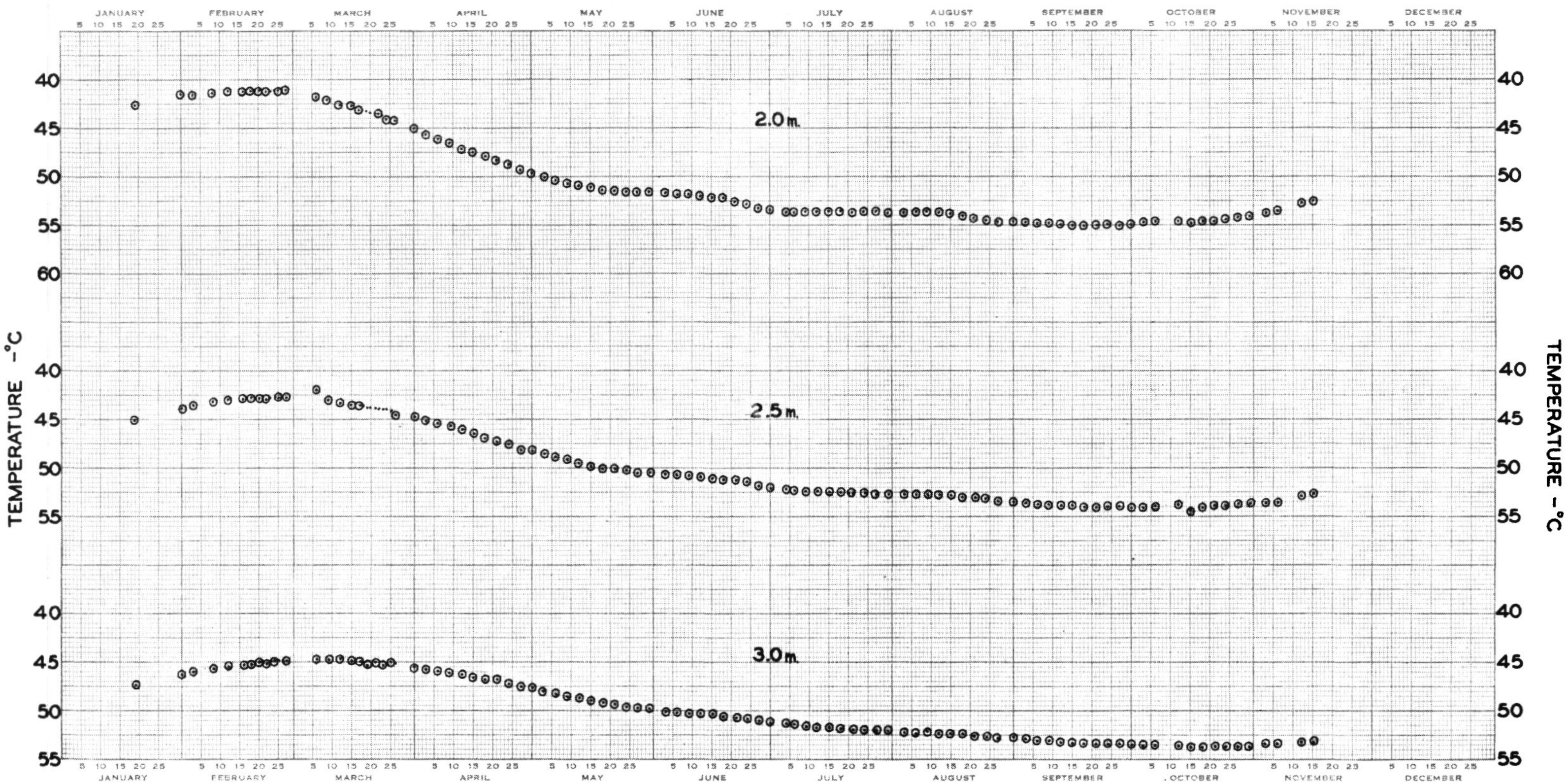


FIGURE 31
FIRN TEMPERATURE - ANNUAL VARIATION

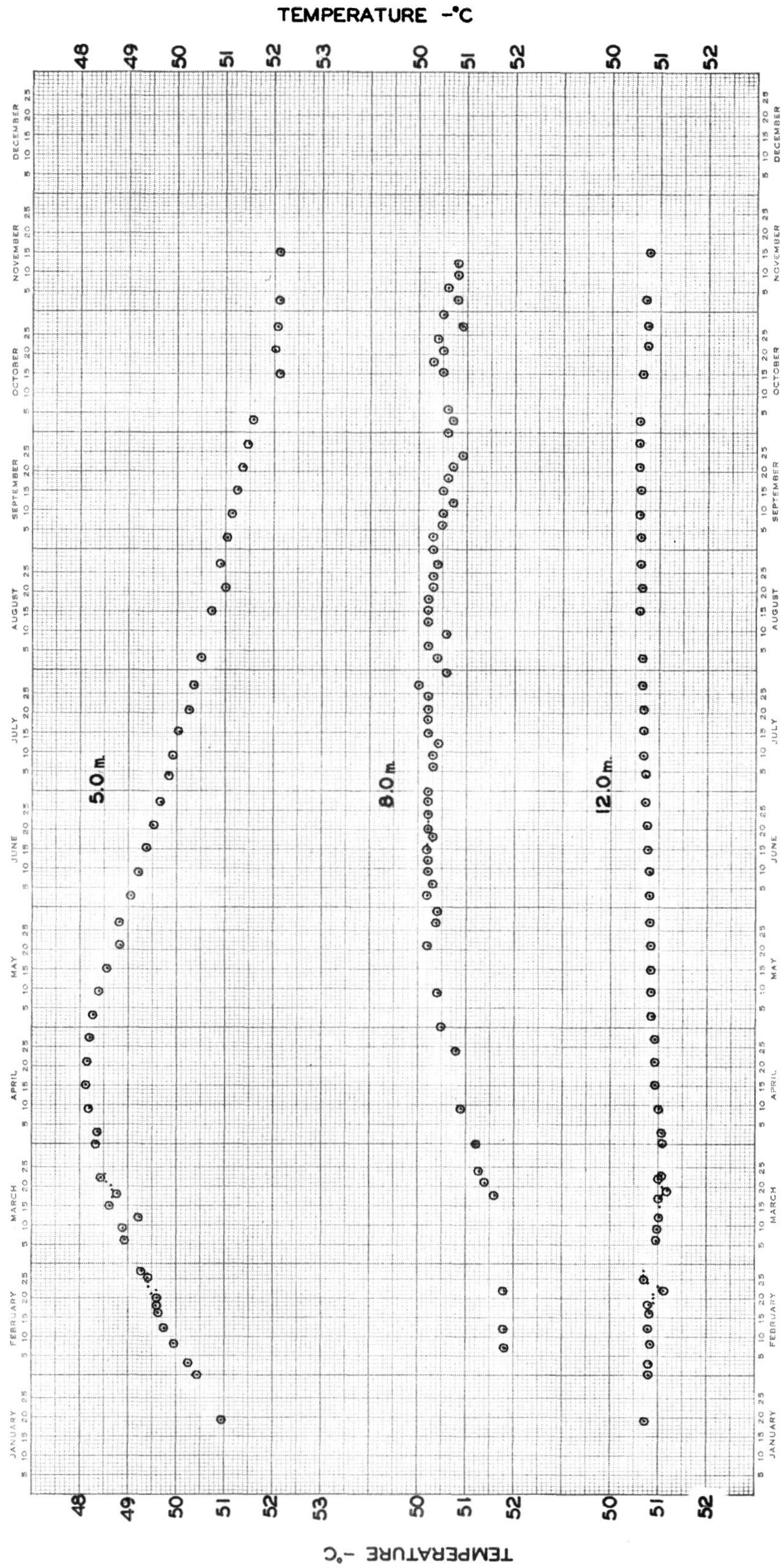
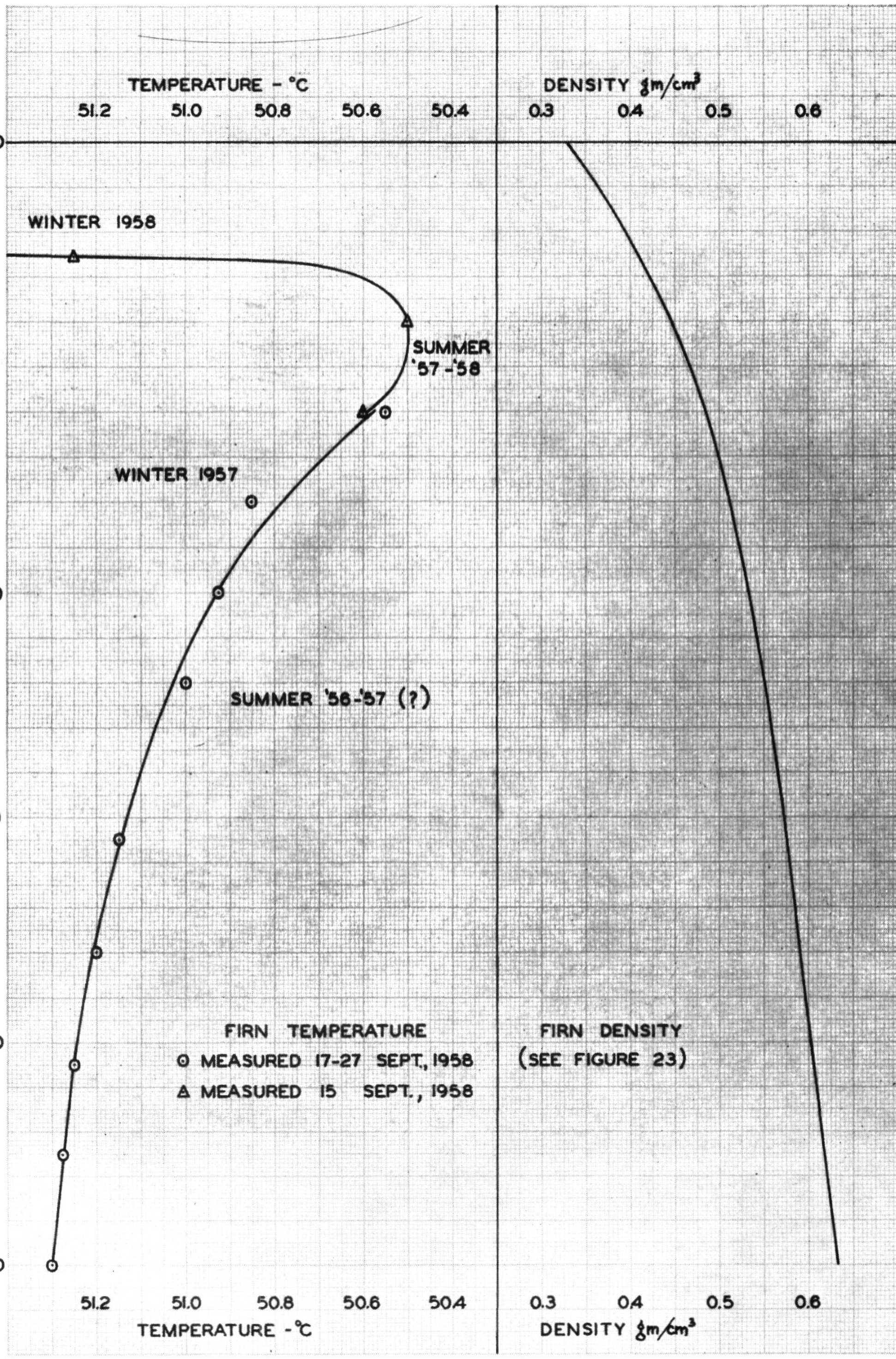


FIGURE 32


DEPTH m.
TEMPERATURE - °C
51.2
51.0
50.8
50.6
50.4
DENSITY gm/cm³
0.3
0.4
0.5
0.6
DEPTH m.
0
10
20
30
40
50
WINTER 1958
SUMMER '57-'58
WINTER 1957
SUMMER '56-'57 (?)
FIRN TEMPERATURE
⊙ MEASURED 17-27 SEPT, 1958
△ MEASURED 15 SEPT., 1958
FIRN DENSITY
(SEE FIGURE 23)

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17. see errata